METAL INDUSTRY

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Changing Times

THIRTY years ago, a university degree in applied science or commerce could be as much a handicap as a help in obtaining an industrial post. Most leaders of industry took pride in the fact that they had come up the hard way and, consequently, were apt to think that this method was the most effective, if not the only, stairway to success. Many were suspicious of the graduate, of his knowledge, his capabilities and, above all, of his ability to fit in in the industrial set-up. The technical graduate himself was well aware that his possession of a degree was no "open Sesame" to the treasure trove of industry; the most that he could hope for was that somehow or other he might creep in through the back door, accept a pittance as the reward for his services, and then, by hard work and grit, coupled with a modicum of luck, prove that his technical training was indeed of some use to his reluctant employer.

Twenty years ago the situation was somewhat improved. A few enlightened firms had begun to appreciate the benefits to be gained by employing graduates. In making these appointments these firms usually relied on the recommendations of professors who knew the capabilities and limitations of their students well; subsequent large increases in the numbers of students graduating have to some degree lessened this intimate relationship. The graduate himself was usually keen on getting a job and was quite willing to take his chance to carve out a worth-while career, and most graduates relied on their own initiative in finding a suitable post.

A glance at the advertisement columns of the national and technical press, or the notice boards of any university, will soon show how times have changed, even in the past decade. University employment bureaux provide an excellent source of information about employment opportunities and guide the footsteps of the uncertain into the proper path. Dozens of elaborate brochures produced by individual companies give details of the opportunities available within their own organization, while firms themselves combine to extol the virtues of their industry. Nowadays, the technical graduate is at a premium, his services wooed by a dozen or more competitive organizations and his future assured. As a result of the employment situation of the past ten years, some graduates feel that their possession of a degree entitles them to be able to pick and choose their job. Not only do they expect assurance of opportunity in the company of their choice but, indeed, many almost expect promotion to be guaranteed. Few would expect to have to use their own initiative to find a job. Within the past few months it is true that this attitude of mind has somewhat improved, in keeping with the employment situation; while it is, perhaps, too much to expect it to change completely overnight, the sooner it does the better for both industry and universities, even though in the foreseeable future the need for technical graduates will continue to grow, and there will always be competition for the best men.

Out of the MELTING POT

Getting Nearer

METALLURGISTS may possibly have been inclined to regard ductile ceramics, work on which was reported a short while ago from America, as something of a nine-days' wonder. It is true that experiments with sodium chloride and magnesium oxide have been successful in making these typically brittle materials exhibit a considerable ductility at room temperature. This success was, however, tempered by the fact that the materials tested were in the form of single crystals, and that the ductility they exhibited was found to be dependent on the condition of the crystal surface, and was also subject to quite rapid loss as a result of some unknown ageing process. The fact that ductile ceramics are, nevertheless, by no means just a nine-days' wonder, that research on various aspects of the phenomenon is continuing, and that metallurgists may yet one day be faced by ductile ceramics in practice, can be deduced from the observation that, of the sixteen Papers on deformation presented to this year's Fall Meeting of the Metallurgical Society of the A.I.M.E., four Papers dealt with the deformation of non-metallic materials: one with the short-term creep of some graphites at 3,000° to 5,300°F., and the other three with plastic flow in sodium chloride and magnesium oxide. In studying the initiation of plastic flow in magnesium oxide single crystals, dislocation half-loops were artificially introduced into the crystal by sprinkling with carborundum. The stress required for the movement of these half-loops was only half that required for the introduction of dislocation half-loops in the absence of the carborundum. Another Paper concerned itself with the effect of water polishing, annealing, and other treatments, which caused changes in the surface and the bulk structure, on the ductility and strength of sodium chloride single crystals tested in flexure. Finally, there was the Paper on the ductility of polycrystalline ceramics. It described experiments in which polycrystalline specimens of sodium chloride were formed by compacting crushed salt prepared from melt-grown single crystals. The effect of various surface treatments applied to the powders before compacting on the ductility of the polycrystalline specimens was investigated. The two treatments so far discovered to be able to impart ductility are: treatment with an ether solution of stearic acid, and vapour deposition of a thin film of silver.

Curiosity Unsatisfied

DIFFERENCES between the practical and scientific approaches to new developments, or new materials strike one forcibly on those occasions when one's imagination, having received a suitable stimulus, at once shoots ahead in its freely chosen direction, only to be checked and made to tread what to it is a much less appealing path. A typical stimulus of this kind is provided, for example, by the title "Zone Melting of Magnesium." Pause for a few seconds and let your imagination take its course. Does it take the zone melting in its stride and hasten on to the resulting refined magnesium? Will zone refining bring the annealing temperature of magnesium down to room temperature or even below, as in the case of similarly refined aluminium? Will there be some radical improvement in the corrosion resistance of the metal? Unfortunately, the abstract that follows the title brings the imagination back to the zone refining process itself, by stating that a description is given of an apparatus, and that a flexible skin was successively introduced on the surface of the molten metal to suppress severe vaporization. The distribution of impurities along the length of the bar to be purified was determined by spectrographic analysis. The effects of the zone speed and the number of passes of the molten zone on the purification have been determined. The values of the effective distribution coefficients of alloying and impurity elements in magnesium determined by this technique are in good agreement with those obtained from the phase diagrams. So much for the imagination. May be, of course, the disappointment over the complete absence of information about the properties of the zone-refined magnesium should be blamed on the abstractor and not on the authors of the original Paper. Since, however, the latter is due to be presented at a meeting, an answer to this question will have to await the by no means certain publication of the Paper some time in the future. What is much more likely is that this particular question will have to go to join the host of other spontaneous questions, answers to which have failed to conquer the limitations imposed by time and space. Perhaps our imagination will be luckier next time we chance upon the subject of zone refining magnesium.

Another Success

ON more than one occasion in the past, a paragraph on this page has been devoted to pointing out the advantages of prefabricated coatings over coatings which are more or less laboriously, and more or less successfully, built up "on site," usually in a number of stages. Surprisingly enough, the practice of applying prefabricated coatings has been slow in developing. Among the reasons for this slow progress must certainly be included the absence of a general recognition of the concept of prefabricated coatings as such. In the absence of this general concept, efforts cannot consciously be directed towards the development of such coatings, and of methods of applying them. Another drawback is that the lack of recognition of the general principle of prefabricated coatings on the one hand, and lack of appropriate terminology on the other, allow examples of the use of prefabricated coatings to pass without any special recognition of them as examples of this method of coating. Plastics-coated metal sheet, for example, may or may not be metal sheet on to which a prefabricated plastics coating has been bonded by rolling and the use of a suitable adhesive. Elsewhere, a benefit to be derived from the application of a prefabricated polytetrafluoroethylene coating has even formed the basis of a patent claim. The specification points out that attempts to use P.T.F.E. coatings as a means of preventing adherence and growth of barnacles on marine structures were unsuccessful when the coatings were produced from colloidal dispersions of the resin. It has now been discovered that suppression of barnacle growth does occur if the P.T.F.E. is applied to the surface in the form of a substantially impervious 2 to 60 mil thick sheet or film (prefabricated coating!).

Skimmer

INSTALLATION OF TWO-FLOOR SYSTEM INCREASES OUTPUT

Conveyorized Shell Moulding

A MECHANIZED foundry system for shell moulding, which has been proved in the company's own foundry and will probably lead to similar installations in other parts of the country, has been installed by Clarke, Chapman and Co. Ltd., of Gateshead. The most significant aspects of this layout are:—

(a) The use of two principal conveyors for transporting a continuous line of tubs which carry the shell mould "biscuit," one conveyor being allotted to equipping the tubs with the moulds and packing sand, and the other to filling the moulds with hot metal.

(b) The use of a non-moulding sand as ballast or packing to assist in keeping the moulds closed.

(c) The use of clamps attached to a secondary conveyor as a further means of closing during the pouring operation.

To appreciate the novelty of the system, it must be noted straight away that the ballast or packing sand is contained in a mechanized closed circuit for recovery and redistribution, while the actual moulding sand supply is not mechanized, at least for the purposes of this particular foundry. Another controlling factor arises from the moulding and tub filling operations occurring on a floor level above the pouring area.

General Arrangement

In general terms, the layout consists of a centrally-situated melting plant, tapped on the low-level floor and charged on the high-level floor. At the rear of this, on the high-level floor, is the shell moulding area and a roller conveyor for tubs, which transport the completed moulds and which are filled with packing sand. At the exit end of this high-level conveyor is a downlift to deliver the tubs to the low-level conveyor. At the entry end of the high-level conveyor is an uplift to return tubs from the low-level to the high-level conveyor after emptying them by a tippler device which separates castings, mould and packing sand. At the front of the melting plant is a low-level conveyor on which pouring takes place. This connects the bottom of the two lifts so that the tubs are, in effect, running in a circle round the melting units. A closed circuit sand recovery system for the packing sand is incorporated.

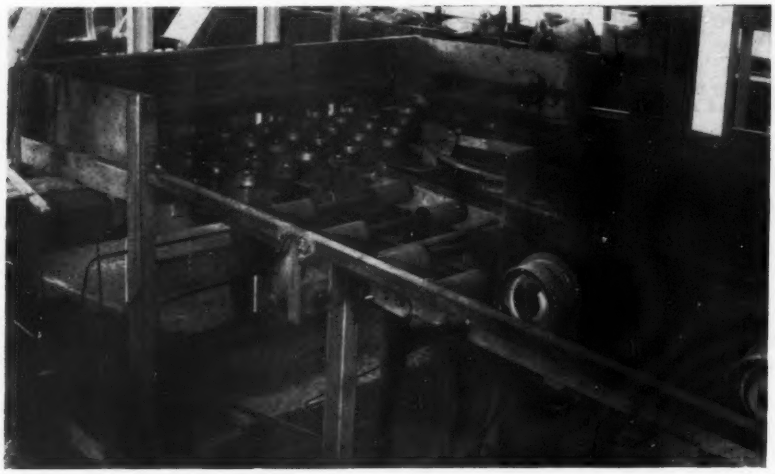
Mould Delivery

Moulding is carried out in two Fairbairn Lawson Combe and Barbour shell-moulding machines located on the upper floor level. The two halves of the mould are closed by clips. Alongside is the tub-filling conveyor. This is an 18 in. wide gravity roller conveyor with a fall of 1 in. in 4 ft. and a length of 150 ft. in four spans side by side, the corners being turned by ingenious pneumatic transfer tables. On the exit side of these, when an outgoing tub leaves the table it releases an air valve, and this, in its turn, depresses a stop which has until then prevented the ingoing tub from moving forward. The movement of the latter causes it to strike a trip valve, which sets in operation a pneumatically-powered drag bar catch—the means by which the tub is hauled across the table over ball tracks so as to be in line with the exit roller conveyor. At this point, two further air valves are tripped, with the result that the transverse drag bar catch is returned, and the tub is pulled out on to the exit roller track by a further pneumatic drag bar.

On this final span of conveyor is the equipment for filling the tubs in three stages. First comes the overhead hopper, delivering returned packing sand through two air-operated gates, hand- or knee-controlled, which half fill each tub; then there is the second stage, at which the completed mould biscuits, with runners and risers, are inserted. When the tub on the conveyor arrives at the third stage, a second similarly-equipped hopper is used to fill it with packing sand—below the riser tops, of course, a lid being put over any mould openings to prevent the sand falling in.

The next stage in the tub's route is to the downlift, which is operated simultaneously with an uplift at the entry end of the high-level circuit to ensure that the high-level and low-level tracks do not become underloaded. As the tub approaches the downlift it passes through an interlock, which prevents a second tub entering the lift gate until the first tub is cleared from the bottom and the lift has returned to the top. The downlift is

General view of the roller conveyor on the high-level floor



Arrangement of the transfer table on the roller conveyor

interlocked with the uplift, so that when one is emptied the other is filled, the connection between the two on the low-level being the main casting conveyor. The tub in the downlift remains in it with the lift at the bottom until the pourer operator depresses a foot pedal switch which moves the low-level or casting conveyor on one tub length. The pedal must be released and depressed again for each such movement, taking one tub out of the downlift at the bottom and placing one tub in the uplift, also at the bottom, simultaneously.

Casting Operation

Meanwhile, the low-level conveyor between the two lifts carries a continuous train of tubs—in this case running on their four side wheels on rail tracks and propelled by an underslung chain from the top of which project pins which engage with the tubs. The sprocket driving this chain is powered by a 5 h.p. motor through a fluid coupling and a worm reduction gear; to ensure that only one tub-length of travel is provided each time the operator works the pedal, a cam placed on the final worm wheel shaft (also the vertical shaft passing through the sprocket) trips an electric switch which applies the motor brake for a predetermined portion of a revolution. This drag conveyor is supported by rollers operating in a channel which is laid out to haul the tubs out of the downlift, past the operator's pouring station, through fume extractor ducting, into the uplift.

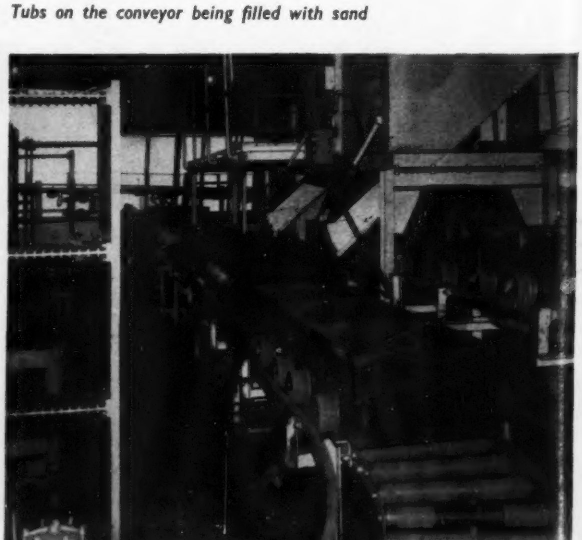
Integral with the framework surrounding this main casting conveyor, and running over it for roughly half its length, is a clamping conveyor. From it are suspended pneumatic clamps designed to provide during pouring a downward thrust on steel plates placed on top of the packing sand in the tubs, which consequently prevent the shell mould submerged in the sand from bursting when filled with hot metal. Associated with the clamps are electrically-energized magnets which, after pouring has taken place, pick up the plates from the tubs as the pneumatic piston constituting each clamp is retracted, by striking a trip lever at the appropriate point in the circuit. Air supply to this conveyor is maintained while it is travelling by means of a self-winding hose reel. It will be appreciated that the thrust from the clamps places special loads on the conveyor and retaining framework. To meet these, the clamp conveyor has been designed so that it consists of a number of carriages, each equipped with one pair of rollers above and two below the tracking, on which they run in order to deal with the thrust in either direction. A chain driven from the main casting conveyor connects the carriages and propels them round the circuit synchronized with the position of the tubs, so that one clamp is suspended from each carriage and two carriages are located over each tub. This allows two pressure plates to be applied to each mould to prevent it opening, the plates themselves being provided with a cut-out to make room for the runners, which are usually of the hot-lip type.

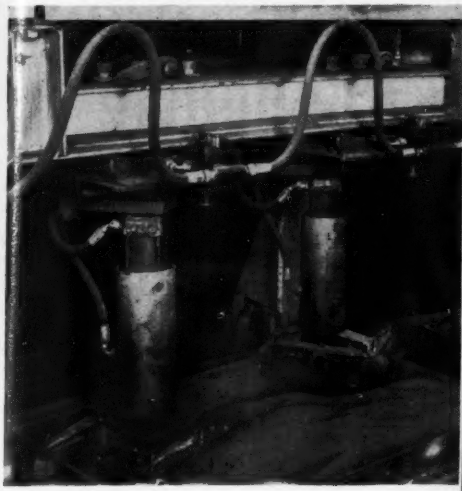
Tippler and Return Circuits

In accordance with the procedure on the casting floor, previously mentioned, as the rear tub leaves the downlift, the leading tub enters the uplift. Both lifts rise together, the downlift empty and the uplift loaded with the leading tub containing the mould filled with metal. When the latter reaches the top floor, it is discharged by gravity into a rotary tippler. Here it strikes an electric switch which operates an electro-pneumatic valve, causing the tippler to rotate through 120° by means of a turncock unit and chain drive. The contents of the tub

One of the shell moulding stations

Tubs on the conveyor being filled with sand





Above: Close-up of the clamps that secure the mould during pouring

Right: Pouring in progress, with the clamps in position

in the tippler fall upon a Sterling Foundry shake-out, slightly inclined so as to ensure the castings are vibrated off and into a chute, while the packing sand and broken mould pass through the grid. Beneath the latter is an inclined vibrating screen, which delivers broken mould pieces from the top of the mesh to a disposal hopper, and the packing sand which passes through the mesh to one of the following routes:—

(a) To half refill the tub at the tippler position.

(b) To the overhead screw conveyor which feeds the hoppers over the tub loading points, adjacent to the mould closing station.

(c) To the spillway chute to the bucket elevator, which raises sand to the main overhead storage hopper.

(d) The sand which falls from the casting is returned by a vertical screw conveyor through the floor grille so that it can rejoin the system by means of the bucket elevator to the main hopper.

The practical result of this mechanization of the Clarke Chapman foundry is that output has been increased from 100 castings per day, weighing approximately 30 lb. each, to 200 per hr. As already seen, one man controls the whole system from the metal pouring station.

It is apparent from even a brief inspection that this Clarke Chapman method of foundry mechanization for shell moulding greatly increased output per unit of time and per man, and is most successful. It has the unusual advantage of being proved by Clarke Chapman in their own foundry, where it may be seen working, before being offered to other foundries.

Thanks are due to the directors of Clarke, Chapman and Co. Ltd. for permission to secure and publish this data, and also to Mr. Hemsley (foundry mechanization manager) and Mr. Bidmead (drawing office) who supplied the information.

Correspondence

Correspondence is invited on any subject considered to be of interest to the non-ferrous metal industry. The Editor accepts no responsibility either for statements made or opinions expressed by correspondents in these columns

To the Editor of Metal Industry

Inexpressible

SIR,—In your issue of METAL INDUSTRY dated 3 October, page 268, "Skimmer" considered the problem of concisely stating the purity of, for example, the various grades of aluminium.

Why not state the *impurity* of the metal, using 0·01 per cent as the unit?

The commercial quality, 99·5 per cent aluminium, would be quality "50"; the newer grade, 99·9, would be quality 10, 4 nines would be quality 1.

To re-convert these numbers to per cent impurity would merely mean moving the decimal point two places to the left.

Such a system would have the incidental advantage of emphasizing the difference between 99·9 and 99·99, small in terms of aluminium but a ratio of 10:1 in terms of impurity.

This is such an elementary idea that it must surely have been considered and discarded. If so, could "Skimmer" give me the objections to it?

Yours, etc.,

Martin L. Hughes.

The British Iron and Steel Research Association,
South Wales Laboratories,
Sketty Hall, Swansea.

Standard Specifications

General Recommendations for the Sampling of Manganese Ore (B.S. 3035: 1958). Price 4s.

BASED on the work of Technical Committee 65, "Manganese Ore," of the International Organization for Standardization, these recommendations are almost identical with the general agreement reached at the I.S.O. meeting in Leningrad in August, 1956.

The 10-page publication relates to the sampling of manganese ore in freight wagons immediately before the ore is loaded into the ship or immediately after discharge at the port of arrival. It is applicable to all manganese ores.

The recommendations concern the size of the ore, the certificated samples, and the number of increments, method of sampling, and the reduction of the certificated sample. An appendix provides a recommended method for locating the points of sampling in the freight wagons.

Copies of the above-mentioned standard may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Atomic Progress

Manufacturing Fuel Elements

In this series of articles, which will be a regular monthly feature, our contributor will review metallurgical aspects of the progress being made in nuclear science. Necessarily, much of the research in this field is directed to the development of nuclear power, and the first article of the series, which appears here, deals with the materials developed for the Calder Hall fuel elements and with the manufacturing techniques which are employed.

RAPID development of nuclear power has brought with it a wealth of metallurgical problems demanding extensive research. In this series of articles it is intended to review some of the metallurgical aspects peculiar to this subject. The nuclear power stations under design and construction in this country are based on the Calder Hall design and it is appropriate, therefore, to begin this series with a review of the Geneva Conference Paper entitled "The Development of Manufacturing Techniques for the Calder Hall Fuel Elements," by F. Butler, J. Harper, I. Morrison and J. Pardoe.[1] In this Paper the authors describe in outline how the major problems associated with the development of manufacturing techniques for this fuel element were overcome. The solutions selected were the best that could be accomplished in the time available, and Mark 1 fuel elements manufactured by this route are fulfilling their operational requirements.

Fuel Element

The fuel element is stacked vertically in the reactor, and consists of a uranium metal rod which acts as a strut carrying the weight of the fuel elements higher in the stack. This rod is enclosed in a finned magnesium alloy envelope or can, sealed at its ends by welding. One end of an assembled fuel element is shown in Fig. 1. In the reactor, it is exposed to an atmosphere of carbon dioxide at about 7 atmospheres pressure, and is subjected to a range of conditions of temperature, load and irradiation.

Bar Manufacture

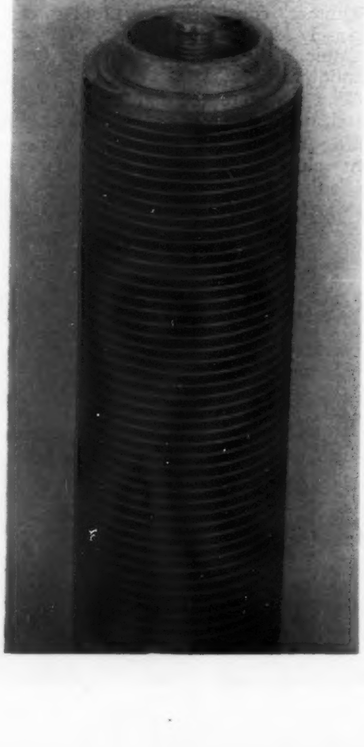
The uranium bars, 40 in. long by 1·15 in. diameter, are cast in preference to fabrication by rolling or extrusion, on the grounds of cost and the greater experience of casting techniques and irradiation behaviour of cast uranium available within the U.K.A.E.A. The metal is poured from a hole in the base of a graphite crucible via a graphite tundish to a distribution plate containing 15 graphite nozzles each feeding a graphite mould. The distribution plate, it is said, also serves as a metal reservoir to feed shrinkage during solidification. The authors indicate that development work showed that straight uranium bars with a minimum metal discard can be cast, using the method described above, into graphite moulds encased in steel for protection during handling. Steel moulds were found to lose straightness, and also resulted in hot tearing due to the faster cooling of the uranium.

Butler *et al* explain that a fine grain size is necessary in the uranium bar to reduce the tendency of the surface to wrinkle during irradiation, and thereby lessen distortion of the can. This is obtained by quenching from the beta phase. The authors briefly describe the techniques studied, and state that the selected method was to traverse quench the bar through a short induction coil and quench immediately in a water spray. This required a generator of small power, and the rapid heating cycle avoided appreciable oxidation of the bar; it also gave less distortion and dimensional changes than were obtained with direct quenching. The technological variables of traverse quenching which had to be studied are listed by the authors, but no details are given.

The bars are next reeled to straighten them, and centreless turned prior to alpha annealing at 550°C. to remove residual quenching and reeling stresses. This sequence was adopted because at the time it was thought that a cold-worked surface on the bar might detract from its dimensional stability in the reactor. It means that the finished bars have a rather thicker oxide film on their surface than if machining followed alpha annealing. In consequence, the temperature difference between the can and the uranium bar is increased during service.

It is interesting to note that, although fluorescent and eddy current techniques were investigated for inspection of the bar surface for cracks, reliance is placed on visual examination.

Fig. 1—One end of an assembled fuel element



Can Manufacture

Cans are made from a magnesium-aluminium-beryllium alloy, for which very rigorous inspection procedures, including ultrasonic inspection, have been developed to ensure that material of the highest quality is employed, free from large flux and intermetallic oxide inclusions. Development work, the authors state, led to the elimination of calcium from the alloy and a reduction in the aluminium content from the original specification. The former change improved weldability, and the second avoided marked grain growth associated with residual stresses from the extrusion and machining operations. Both features are of great importance from the viewpoint of fuel element performance.

The can itself has a wall thickness of about 0·060 in., and has circumferential fins about 0·030 in. thick, spaced 0·100 in. apart. At the time, fabrication by mechanical working was not possible, and a machining technique was developed. Because of the close tolerances demanded, solid bar was preferable to hollow tube as the starting point. It is of interest to note that this type of can may now be produced by Integron rolling[2] and also that considerable progress has been made in the extrusion and twisting of multi-start deep spirally finned cans.

Canning Operation

An end cap is welded into one end of the can and then the uranium bar is inserted, the fuel element helium filled, and the second end cap welded. Cup-shaped end caps are employed, and these are edge welded to the can, using an automatic argon arc welding machine. The authors state that moderately deep end caps are employed to reduce restraints during welding and provide some flexibility, so that the weld is not

(*Continued on page* 378)

Finishing Supplement

Chromium Plating on Sprayed Metal

By R. de BUYER

At the Second International Metal Spraying Conference held recently in Birmingham, under the auspices of the Association of Metal Sprayers, a variety of Papers covering many aspects of sprayed metal coatings was presented. Two of these, which are translated from the French, are published here and a selection of the others will appear later.

IN general, the fields of application of hard chrome plating and metal spraying are totally different. This is quite understandable since the characteristics of the coatings produced by the two processes are dissimilar. Thus, sprayed metal deposits must have a minimum residual thickness after machining. There are, however, no upper limits to the thickness of the layer, and in practice layer thicknesses of $\frac{3}{8}$ in.-$\frac{3}{4}$ in. are common. On the other hand, with hard chrome plating, there are many cases where the thickness of the deposit is 0·01 mm. or less, and while thicknesses of 0·3-0·4 mm. are quite common, a thickness of 1·0 mm. is rarely reached.

In practice, the hard layer of chromium deposited by electrolysis is employed by virtue of its surface properties (hardness, its property of accepting a high degree of polish, its low coefficient of friction and resistance to wear) rather than as a building-up layer to replace metal worn away, except naturally when the wear is quite small (of the order of a few "thou").

The conventional method of dealing with parts which have been subjected to heavy wear (1·0 mm. or more) and which, therefore, cannot be solved by hard chrome plating alone, is to deposit first a thick layer of nickel, which after machining is hard chrome plated.

Thick nickel deposits, however, have their limitations. First, the rate of deposition of nickel from an electrolytic bath is low, 0·004 in/hr., at a maximum, and it may, therefore, take several weeks to produce the required thickness of nickel. This may be too long to be acceptable when a worn part has to be repaired. Secondly, if the part to be built-up contains blow-holes it is almost impossible to fill them by nickel plating. It is true that a mechanical means of dealing with this difficulty is available, namely, by drilling the blow-hole to a larger size, forcing in a pin and machining flush. But this process cannot be carried out if the wall of the part in question is thin (e.g. a hollow cylinder).

As a practical solution to many building-up problems, metal spraying with steel prior to hard chrome plating offers certain advantages. For instance, the price of the steel used for spraying is less than one-quarter that of nickel. Again, the rate of deposition by means of the spray-gun is extremely high, compared with the slow rate of the electrolytic nickel-plating process. In emergencies it may frequently be possible to complete the spraying operations in one day.

Local building-up of metal can also be carried out, and it is possible to remove all surface flaws, such as pitting and blow-holes, and to obtain a continuous surface by means of the spray gun. Under practical conditions such surfaces are obtained by spraying with either steel or copper.

Three applications which demonstrate the capabilities of this combined process are discussed below.

In the first case (Fig. 1), the chromium plating had worn off an aircraft damper-piston which originally possessed a mirror-polished chromium-plated surface.

Conventionally, it would have been repaired by stripping the chromium deposit, replating with chromium to a thickness of about 0·5 mm. (0·02 in.), followed by grinding to finished size, leaving a chromium deposit of about 0·1 mm. Owing to the presence of heavy corrosion, to a depth of some tenths of a millimetre at *A*, and to the insufficient wall thickness of the cylindrical part (3 mm. or approx. $\frac{1}{8}$ in.), it was impossible to carry out this procedure.

For this reason, building-up by spraying was considered. Test pieces, artificially worn in places by grinding, were treated by the following procedure:—(1) Local sand-blasting. (2) Molybdenum deposition. (3) Steel deposition. , (4) Grinding.

The part was then chromium-plated. The result was unsatisfactory, a groove being formed at *A* because the molybdenum had been attacked by the chromium-plating bath.

The following procedure was then tried out:—(1) Local, but more intensive, sand-blasting. (2) Steel spraying. (3) Grinding. (4) Rubbing down, using emery cloth. (5) Hard chromium-plating to a depth of 0·2 mm. (6) Grinding the chromium, leaving a depth of 0·10 mm. (7) Polishing and burnishing (mirror polish).

The result was quite satisfactory. Although the porous texture of the sprayed metal is quite different from that of the original steel, the texture of the chromium deposit is quite homogeneous.

After grinding and polishing it was impossible to distinguish where the building-up by spraying had been carried out.

The second example is that of a machined cast-iron roller for paper-making, shown in Fig. 2. It should have been chromium-plated with a mirror-polish finish, but owing to a large number of surface flaws (pitting and blow-holes) the chromium-plating could not be carried out. The part should, therefore, have been rejected. It was possible to save it by copper-metallizing, employing the following procedure: (1) Machining the piece to reduce its diameter by 3 mm. (about $\frac{1}{8}$ in.) to leave room for the copper. (2) Conventional threading to prepare

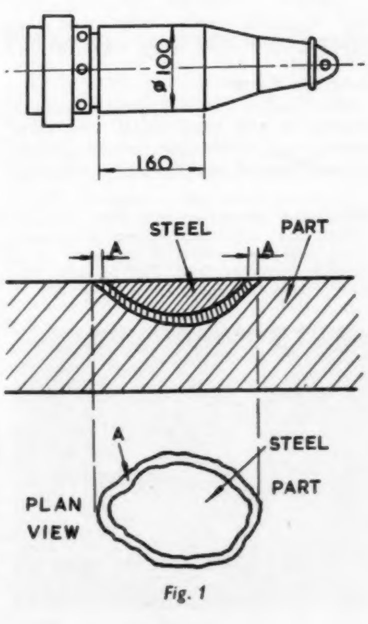


Fig. 1

Fig. 2

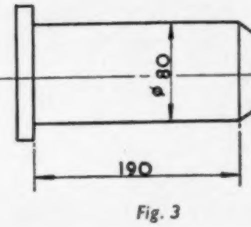


Fig. 3

the piece for the layer of copper. (3) Spraying of copper, with a machining allowance. (4) Machining the copper down to the required dimension, so as to leave a copper thickness of 1·5 mm. (5) Chromium-plating the surface with a thickness of 0·1 mm. before grinding. (6) Mirror-polishing the chromium plating.

The result was excellent, the chromium surface being entirely free from flaws.

It should be emphasized that metal spraying from a spray gun was the only process capable of saving this piece, which otherwise would have had to be scrapped.

Finally, the piston of a pump for artificial silk, repaired by the combined method, is shown in Fig. 3. These pieces are chromium-plated, and are periodically returned for replating after wear. Their condition then is such that they present various surface faults, such as grooves (scoring).

After removal of the old chromium-plating, they must be reground before replating. Their diameter is, therefore, reduced with each repair cycle. Since the corresponding cylinder is reduced each time, the thickness of the chromium-plating increases at each repair cycle. When the thickness of the chromium deposit reached its safe limit, the piece was built up to its original dimensions by metal spraying. The following procedure was employed: (1) De-chroming. (2) Machining, to remove all surface faults and ensure that the piece is round. (3) Sandblasting. (4) Deposition of molybdenum. (5) Deposition of steel. (6) Grinding the layer of steel. (7) Polishing with emery cloth. (8) Hard chromium plating, oversize. (9) Grinding down to the original dimensions. (10) Mirror-polishing.

From these examples it will be seen that it is possible to build up the surface of a part, under satisfactory technical conditions, with sprayed metal, followed by hard chrome plating. The procedures employed for combining these two processes are quite simple, and parts repaired in this way have proved completely satisfactory in service. Compared with the cost of a new part, considerable savings can be effected by adopting this method of building-up.

Sprayed High Melting Point Metals

By J. CAUCHETIER

As the type of adhesion obtained when molybdenum is sprayed on steel appears to be different from that obtained when common metals are sprayed, experiments were carried out to determine its nature.

Examination of micrographs of molybdenum-sprayed steel at low magnification (×200) showed that with an ordinary sand-blasted surface there is a fairly rough area at the interface, whilst with an ordinarily cleaned surface the interface is quite smooth and dull, due, probably, to differences in hardness. At higher magnifications (×800) a very sharply defined transformation area is visible (about 10μ) caused by the formation of an alloy, the nature of which cannot be determined by simple micrographic observation. Microhardness tests clearly showed an increase in hardness in the neighbourhood of the interface. Thus, the base metal has a hardness of 200 Brinell, changing to 700 Brinell near the interface, and the molybdenum coating has a Brinell hardness ranging from 515-600.

Contact surface of sprayed iron on sandblasted surface. (×1,000 reduced 2 : 1). Note that the hardness of the base metal has not changed up to the point of contact.

The results were not affected by the type of pistol used, except that the sprayed metal was more oxidized by the electric arc than by the oxy-acetylene flame.

The effect of different surface finishes of the basis metal was then investigated. Molybdenum was sprayed on sand-blasted, mechanically polished, and electrolytically polished mild steel. With the electrolytically polished surface no adhesion was obtained because no alloying took place, but with both mechanical polishing and sand-blasting an incipient alloy layer was formed.

The degree of adhesion obtained depends on the type of gases used and the adjustment of the flame. Thus, if good adhesion is obtained using a reducing oxy-acetylene flame, the same setting with oxy-propane will produce molybdenum which is considerably oxidized, and adhesion will be poor. No adhesion is obtainable on a mechanically polished surface, but on a sand-blasted surface there is slight mechanical adhesion but layers of oxide varying in thickness from 5-10μ inhibit the formation of an alloy layer, as micro-hardness tests prove.

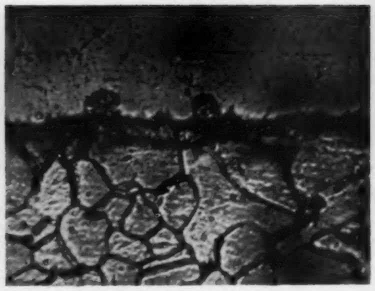
To prevent this oxidation, the molybdenum was covered with aluminium or a cellulose coating. The presence of aluminium inhibited the formation of an alloy, but the cellulose coating does not, and may even help it.

Molybdenum sprayed on mild steel (×800 reduced 2 : 1). The transformation zone 8 to 10 microns thick at the point of contact with the molybdenum is clearly indicated

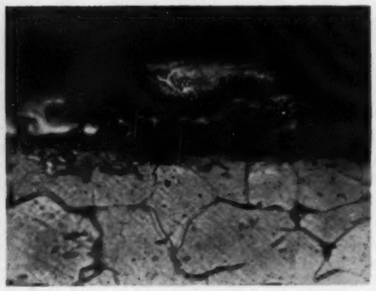
Molybdenum sprayed on mild steel (×1,350 reduced 2 : 1). Note the difference in hardness of the base metal near the interface. (The hardness increases from 200 to over 700 Brinell, that of the molybdenum being 670)

Molybdenum sprayed on electrolytically polished mild steel. (×900 reduced 2 : 1). Note the absence of transformation zone, and that the hardness of the base metal near the contact face is not affected

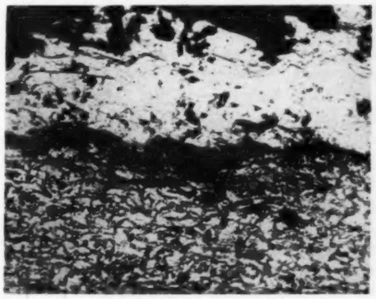
Ferro-molybdenum (60 per cent molybdenum) coating on mild steel, using powdered metal. (×900 reduced 2 : 1). No transformation zone, and no change in hardness of base metal



Deposit of molybdenum-tungsten alloy (50/50). (×800 reduced 2 : 1). Note transformation zone



Tantalum sprayed on to mechanically polished mild steel. (×900 reduced 2 : 1). Note that the metal is highly oxidized. There is little or no effect at the contact surface



Coating sprayed from aluminium-covered molybdenum wire. (×200 reduced 2 : 1). The heavy layer of oxide at the contact surface has prevented adhesion

Sprayed coating of nickel-molybdenum-tungsten alloy (44/28/28) on sandblasted mild steel. (×800 reduced 2 : 1). Note transformation zone at contact surface

Pure tungsten sprayed on mechanically polished mild steel. (×2,000 reduced 2 : 1). Note very clear zone of transformation

Tests were also carried out with other metals and alloys. Where possible, wire made from the given alloy was used. In other cases the wire surrounded by a tube of another metal was employed, or a metal tube filled with powder made from the metal under test where it was not possible to draw this metal into wire.

Alloying took place at the interface when pure tungsten, and alloys of 75 per cent tungsten-25 per cent molybdenum, 65 per cent tungsten-35 per cent molybdenum, and 50 per cent tungsten-50 per cent molybdenum were sprayed on to mild steel.

On the other hand, sprayed Hastelloy alloys containing chromium 16 per cent, nickel 56 per cent, molybdenum 17 per cent, iron 6 per cent, tungsten 5 per cent, gave no alloy layer, nor did the spraying of a powder made from ferro-molybdenum containing 60 per cent molybdenum, although the melting point of the alloy used was between 1,450° and 1,500°C. Similar results were obtained with spraying tests with twisted wire composed of molybdenum 55 per cent, nickel 45 per cent, or molybdenum 30 per cent, tungsten 30 per cent, nickel 40 per cent.

On the other hand, when molybdenum wire in a mild steel tube (60 per cent molybdenum, 40 per cent iron) was sprayed, a non-continuous alloy layer was obtained; many areas, however, were oxidized, and in these areas it was observed that no alloying took place.

An alloy layer begins to form when a ternary alloy of nickel 44 per cent, molybdenum 28 per cent, and tungsten 28 per cent is sprayed on to a sand-blasted surface; there is no adhesion on a mechanically polished surface.

The spraying of titanium gives a highly oxidized metal and there is no alloy formation. Pure tantalum also gives a rather oxidized spray with no adhesion to the surface.

It seems that in several cases the metals sprayed may form a sort of superficial micro-brazing with the basis metal. To obtain such a result it is essential that the metals are capable of forming an alloy with each other, that the melting point of the metal sprayed is higher than that of the basis metal (800°-1,000°C.) and that, if any oxidation takes place, the oxide formed should be volatile.

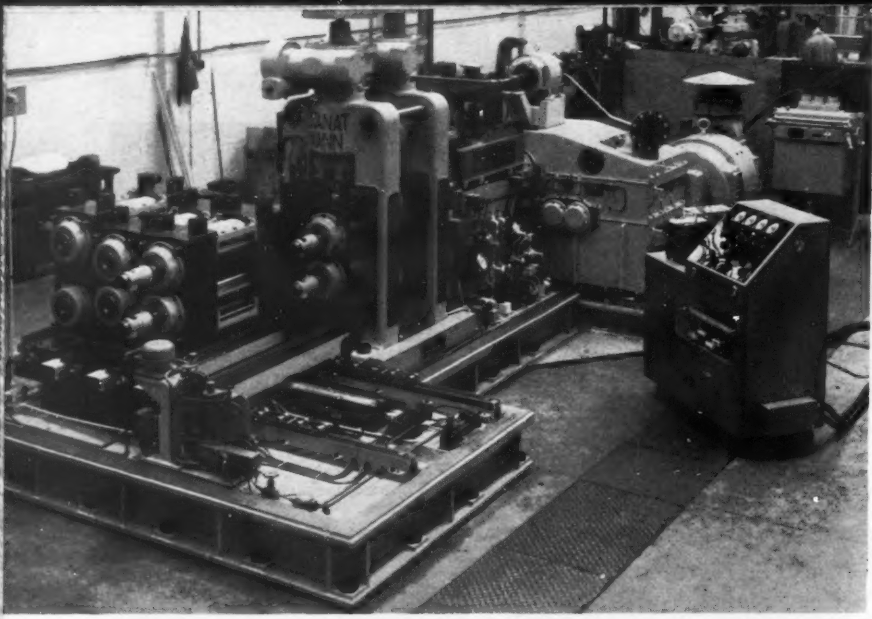
Men and Metals

A director of Spartan Steel and Alloys Limited, **Mr. Z. Stokowiec,** B.Sc., A.M.I.Mech.E., F.I.M., has recently been appointed to the board of Tyseley Metal Works Limited.

Staff changes at the Atomic Energy Research Establishment at Harwell have been announced as follows:—**Dr. J. V. Dunworth,** formerly head of Reactor Division, has been appointed assistant director (Reactor Research Policy), and in this post he will be special adviser to the Director of Harwell. He will be succeeded as head of Reactor Division by **Mr. T. M. Fry,** who has been deputy head of the division. **Dr. Peter Thonemann,** head of the Controlled Thermonuclear Reaction (Fusion) Division at Harwell, has been granted study leave for one year from March next year. He will be going to the Institute of Advanced Studies in the University of Princeton, where he will work on plasma physics. The Harwell fusion programme will be carried forward by his deputy, **Mr. R. S. Pease,** under the supervision of **Mr. D. W. Fry,** who is deputy director of Harwell with special responsibility for this work.

It is reported that **Dr. H. M. Finniston** has been appointed research manager of C. A. Parsons and Company's nuclear research centre. It is understood that the U.K. Atomic Energy Authority has agreed to release Dr. Finniston, who is at present head of the metallurgy division at Harwell.

The second annual Gregory Award, presented for the year's most outstanding contribution in the field of semi-automatic electric arc stud welding, has been won by **Dr. J. C. Chapman,** of the Civil Engineering Department, Imperial College of Science and Technology, London, for his Paper on "The Application of Stud Welding to Vibrating Wire Strain Gauges." The $1,500 award is sponsored by Gregory Industries Inc., licence associates of Crompton Parkinson (Stud Welding) Ltd.



A general view of the Stanat-Mann mill showing the roll-changing table, the control desk, the driving motor, the main gearbox and the hydraulic setting position. The two circular scales above the rolls indicate the roll screwdown position

Remote-Controlled Rolling

FULLY AUTOMATIC CONTROL OF OPERATION AND ROLL CHANGING

A DEVELOPMENT that may well have far-reaching influence on rolling mill design was on show last week at the Basildon works of Albert Mann's Engineering Co. Ltd. Although the mill demonstrated was intended for the processing of metals used in nuclear applications, and specifically for those needing special care in handling, i.e. radioactive materials, etc., the novelty of the automatic roll-changing mechanism and the remote control of the entire operation will be of interest to many other industries, and automatic roll changing may well have a wide field of application.

The particular line of development for the Stanat-Mann mill has been via the nuclear power industry, in which the utilization of the heat of the fission process for power generation and other industrial purposes is influenced by the design of the reactor core and its fuel element components. Depending upon the design of the reactor, fuel elements can take a variety of shapes and configurations, including (a) flat, curved, and corrugated plates; (b) solid and hollow slugs; (c) rods; (d) tubes; (e) plate, slug, rod and tube assemblies, etc., and in addition to containing uranium, thorium, and plutonium in metallic or compound form, may involve non-fissionable materials including stainless steel, aluminium, magnesium, zirconium, beryllium, titanium, nickel, chromium, copper, silicon, niobium, molybdenum, and their alloys. The production of plate and sandwich form elements might, for instance, derive from the mill described here.

Although plutonium 239 is not amongst the most radioactive materials, it has been found necessary to handle it with extreme care, and very rigid safety regulations are laid down against the relatively low penetration ability, and to prevent the inhalation of plutonium-bearing dust. One safety precaution adopted is to enclose the equipment by means of a "glove box," which can be of stainless steel and Perspex or glass, and is usually fitted with Neoprene gloves entering the enclosure for operation of the plant within. A further advantage of this type of enclosure is that an inert gas at a small negative pressure can be introduced, enabling the rolling to take place of materials which would otherwise suffer from oxidation.

Since at this initial stage the quantities involved in individual fuel element fabrication orders are likely to be small, most establishments and companies likely to enter this field desire to limit their capital investment as much as possible; thus, while conventional practice could call for a 2-high hot breakdown mill, a 2-high cold intermediate mill, a 4-high cold sheet finishing mill, and possibly a form rolling mill, an obvious preference arises to use a single machine capable of handling their entire rolling needs. Hence has arisen the development of the Stanat-Mann 2-high/4-high combination mill, arranged for rolling of difficult metals employing all the roll configurations mentioned earlier.

Having already supplied specially designed small mills of this nature to A.W.R.E.; Commissariat a l'Energie Atomique, in France; Centre d'Etude pour les Applications de l'Energie Nucleaire, in Belgium; Culcheth Laboratories of the U.K.A.E.A. and the Dounreay Establishment of the U.K.A.E.A., Albert Mann's Engineering Co. Ltd. were re-approached by Commissariat a l'Energie Atomique to consider a similar application but involving a much heavier mill.

The 10 in. dia × 14 in. face width 2-high/4-high combination mill is the culmination of ideas formulated in designing the smaller mills referred to above, but carried a stage further to enable the changing of the roll assemblies to take place by powered means because of the larger weights involved. The remote control of this mechanical changing of the roll assemblies brings with it, however, many problems which do not appear with manually-operated mills.

The basic design of the mill was adapted to the peculiar application and incorporates the use of four separate roll configurations, which are automatically and remotely interchanged. The mill has a 600,000 lb. maximum rolling load capacity at a speed of 100 ft/min., is fitted with an infinitely variable speed 2 h.p. screwdown motor drive and a 100 h.p. electronically-controlled Ward-Leonard type main mill drive. Screwdown pressure gauging and metering of the torque transmitted through the universal joint spindles have been incorporated. It is arranged for sealing within a glove box enclosure, the reduction gears and pinion stand, and the drive motor, being outside.

Roll Changing Mechanism

The roll changing mechanism is actuated from the control desk and requires the selection, by a switch, of whichever roll assembly the rolling operation to be performed necessitates. Operation of the change button brings about the complicated electro-hydraulic sequence of (1) disconnecting the screwdown from the top roll, (2) elevating the screwdown to a position which will accept any roll configuration, (3) withdrawal of the gibs which retain the chocks in position in the mill housings, (4) withdrawal of the roll assembly on to the roll carriage, (5) support of the universal spindles whilst withdrawing the roll assembly, (6) indexing of the roll carriage to line up the new roll assembly selected, (7) adjustment of the universal spindles to cater for the roll centres of the selected roll assembly, (8) entry into the mill of the

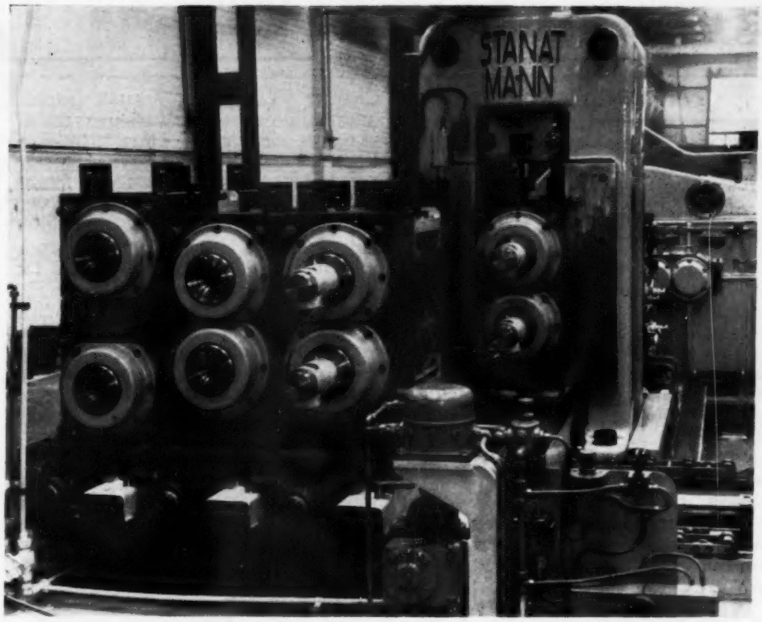
new roll assembly, (9) locking into position of the chocks by the gibs, (10) collection of the new top roll assembly by the screwdown mechanism, with, it should be noted, prevention of any major screwdown pressure being applied when there is no material between the rolls.

The movements involved in the above operations represent, perhaps, the major item of interest as far as the mill itself is concerned, but mention will be made of other individual items.

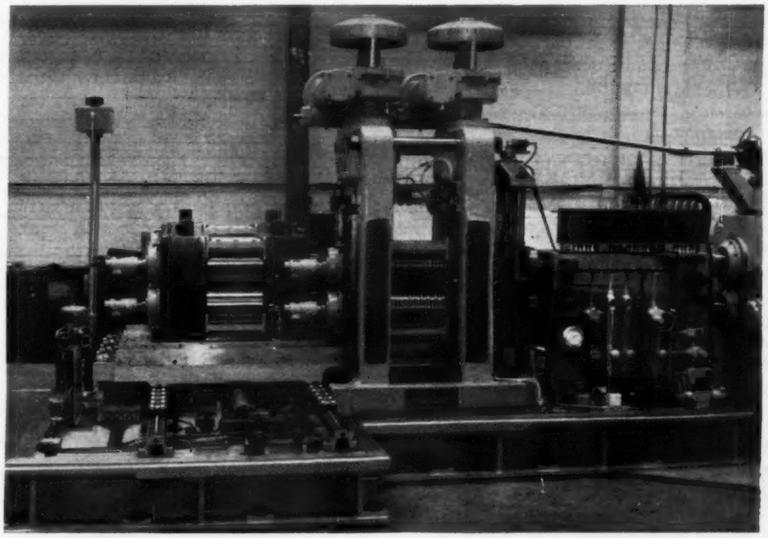
The rolls are adjusted by means of a 2 h.p. infinitely variable speed drive motor through a double worm reduction to the screwdown spindles, a magnetic clutch enabling individual adjustment of each side of the mill to take place. Screwdown speeds are variable from 0·182 mm/sec., for cold rolling, up to 2·6 mm/sec., for hot rolling. It will be noted that the screwdown motor drive is arranged outside the glove box enclosure because of the detrimental effect on the equipment if arcing takes place on the motor armature within an inert atmosphere.

A comprehensive system of instrumentation is fitted, allowing left-hand or right-hand roll pressure, or the sum of both, to be read at the control desk. These pressures are measured by load cells situated between the screwdown and the top roll chocks. Measurement can also be made of the upper roll neck torque, lower roll neck torque, and the sum of both. These are measured on the universal driving spindles by strain gauges, the signals being transmitted via slip rings and brushes mounted on the universal joints. A 2-pen high speed recorder is provided at the control desk for the recording of the roll pressure and roll neck torque.

A combined Timken - mounted double helical reduction gear and pinion stand, designed at Basildon, transmits the torque to the universal joint spindles, the gearbox itself being driven by a Crompton Parkinson 26/100/100 h.p., 200/750/1,500 r.p.m., 0/420 V, 191 amp., ventilated and separately excited motor, the prime mover being a Ward-Leonard set comprising a Crompton Parkinson 1,450 r.p.m., 0/420 V, 191 amp., shunt wound motor generator set mounted on a common bed plate. Ward-Leonard control is used, because it is the most economical way of obtaining the drive motor speeds required, namely, 80-160 ft/min. constant horse power range and 5-80 ft/min. constant torque range.



End view of the roll magazine showing the four sets of rolls, No. 1 set being in position. On the extreme left is the 4-high roll set. The spur gears shown on the left engage with the hydraulic motor gear, when the table is in the correct position for the insertion of a new roll set



Front view cf the mill stand. The whole of the equipment shown here will be enclosed in a glove box in an atmosphere of argon gas

Control Equipment

The control equipment, developed by the electronic laboratory of Albert Mann's Engineering Co., is extremely flexible in operation over the required speed range, shows economy in capital cost over conventional methods of control, and is based on a new technique of pulse-controlled thyratrons, for which patent application has been made. The pulse control method is used because it is independent of anode wave form, does not drive the grid positive at any time and, in consequence, an extremely stiff control of the firing angle may be obtained without the use of feedback control.

Due to the extreme compactness of the electronic components, a space saving for the equipment itself and for spares storage can be obtained of something in the order of 8 to 1. This will be evident in the control console illustrated, which not only incorporates the variable speed control for the 100 h.p. mill drive, but also the 2 h.p. variable speed screwdown motor control, all the relays, etc., associated with solenoid control of the hydraulic circuits, and also includes the amplification and recording required by the torque and screwdown pressure system. Very high orders of speed stability and control can be obtained with this equipment, enabling close automatic control of tension and making programme control comparatively simple.

Readers' Digest

TECHNICAL TERMS

"Chambers Technical Dictionary." *Published by W. and R. Chambers Ltd., 11 Thistle Street, Edinburgh. Pp. vi + 1,028. Price 35s. 0d.*

SINCE its first appearance in 1940, this technical dictionary has been issued in seven revisions, followed by two reprints. With this third revised edition and supplement, the range of terms has been further brought up to date, although it is clear that, in face of current technological progress, no dictionary can cope with the new usage that is being given to familiar words in unfamiliar contexts. Nevertheless, this book will be a valuable aid to many students and others, in fields that range from geology to nuclear physics, from botany to psycho-analysis.

The list of names of contributors to the present edition is an impressive one, and the comment in the preface to the effect that actual usage has been given greater weight than etymology will be welcomed by all readers. Metallurgical terms appear to be well represented.

STRUCTURES OF METALS

"A Handbook of Lattice Spacings and Structures of Metals and Alloys." *By W. B. Pearson. Published by Pergamon Press Ltd., 4-5 Fitzroy Square, London, W.1. Pp. x + 1044. Price £13 2s. 6d.*

THE first thing that one notices about Dr. Pearson's handbook is the price, which will unfortunately put it out of reach of most private buyers. It should thus be made clear at the outset that if you can afford twelve and a half guineas for a personal copy, it is extremely good value for money. Certainly any reference library, or metallurgical, physical, or chemical laboratory, will find it an invaluable investment, which will quickly pay for itself in time and money saved.

The book is in two parts. Part I contains five introductory chapters, outlining the uses of structure determinations and lattice spacing measurements in studies of equilibrium diagrams, alloy theory, physical properties, etc. Although discussions of these topics are to be found in other textbooks, it is useful to have a collected survey of the structural aspects, especially as it includes much recent work. Those who do not care for alloy theory can forget about Part I; the purchase price is well spent on Part II. This contains over 950 pages of carefully arranged structural data, forming the most comprehensive compilation of its kind ever published. Chapter VI gives crystallographic information about the various types of structure described in "Strukturbericht," and some more recently determined structures. Then follow tables in which lattice spacings, space group, atomic parameters, and other data, are listed in turn for the elements, for intermediate alloy phases, and for metallic borides, carbides, hydrides, nitrides, and binary oxides. It should be realized what "tables" in this connection implies; that on alloy phases, for example, takes 80 pages. The final summary table gives a useful grouping of known intermetallic phases according to structural type.

Chapters XI and XII are the most valuable part of the book. They are alphabetical abstracts of all structural work on metals and alloys, and on the metallic borides, carbides, etc., respectively, and give full critical data and references. All the information summarized in the preceding tables is given here in full measure, including large numbers of very well drawn and legible line diagrams. In the 650 pages of Chapter XI, there is inevitably much information on the relevant equilibrium diagrams, but the author is careful to point out that equilibrium diagram work as such has not been assessed and checked with the thoroughness applied to the X-ray work.

A conscientious reviewer of a work of this kind must answer two further questions: are the data complete, and are they accurate? Dr. Pearson tells us that the literature has been thoroughly surveyed up to the end of 1955, and the main journals have been followed through 1956. The present reviewer has tested a number of random samples for both completeness and accuracy, and in no case has he found a mistake. It seems almost incredible that there should be no misprints in 1,044 pages of closely printed text, but the reviewer has not found any. The only minor omission noted is in the discussion of magnetic effects in Chapter IV, where an important recent Paper is not mentioned, although it is fully abstracted in Chapter XI.

When Dr. Pearson was in Oxford, he was noted for his habit of working in the laboratory until 2 a.m., going home to bed, rising again at 6 a.m. to dig his garden, and reappearing in the lab. at 9 a.m. Judging from this book, and the Papers he has published in the last six years, his sleeping time must have been drastically reduced since returning to Canada! The book is very well printed and produced, and author and publisher are to be heartily congratulated on a major contribution to scientific literature.

J. W. C.

Atomic Progress—*continued from page 372*

strained immediately by the onset of distortion. Thin magnesium alloy discs separate the end caps from the uranium bar and help to reduce the end cap temperature. At one end, this disc incorporates a knife edge, and is screwed into a shoulder in the can to form a temporary seal during helium filling. The helium is required for leak testing each assembled fuel element, using a mass spectrographic technique.

Prevention of Ratcheting

The thermal expansion of magnesium is roughly twice that of uranium and, therefore, a method of preventing distortion of the can at temperature is required. The authors describe various methods that were examined to achieve this. These included the use of bars with dumbbell ends, and of bars threaded along their length. The former, it is stated, was unsatisfactory because the centre of the can could move away axially from the centre of the bar during thermal cycling, and the latter was thought to remove too much uranium. Ultimately, a series of rectangular grooves were provided at intervals of a few inches and the can forced into these by gas pressure at about 500°C. The groove shape was selected so that it could be pressurized at a reasonable pressure at this temperature, and so that the can does not lift out or shear the edge of the impressed ring, whilst removing a minimum amount of uranium.

Decontamination

Before a fuel element can be charged into a reactor, any contamination of the surface must be reduced to a very low level. This is necessary to ensure that the sensitivity of the burst slug detection gear is not reduced, and decontamination is achieved by mechanically brushing the fuel elements in a dilute aqueous solution of citric acid.

In conclusion, the authors indicate that the next main aim is to maintain the necessary standards to meet the operating requirements while reducing production costs.

References

[1] F. Butler, J. Harper, I. H. Morrison and J. A. Pardoe; "Development of Manufacturing Techniques for Calder Hall Fuel Elements." Geneva Conference Paper A/CONF 15/P/317.
[2] S. S. Smith and L. R. Hawton; *The New Scientist*, 1958, April 24, 28.

Industrial News *Home and Overseas*

Future Nickel Supplies

An era of ample supplies of nickel was forecast by Dr. J. F. Thompson, chairman of the **International Nickel Company of Canada Limited,** at a press conference in London last week. During the current year, nickel has been a surplus commodity, and Dr. Thompson said that it was his company's intention to continue to produce in surplus in order to give confidence to consumers of assured supplies and a stable price. His view, based on American consumer orders, was that the United States began to shift out of its period of recession in July this year, and that the current trend was for orders to increase in number and value.

Stainless steel, which at present accounted for about 30 per cent of nickel purchased, promised the biggest potential outlet for nickel, but considerable effort was being applied to the introduction of new uses for the metal. Nickel plate accounted for between 15 and 18 per cent of consumption, and constructional alloy steels were the next important outlet. The International Nickel Company's operations were at present strike-bound, but stocks were sufficient for about seven to eight months' requirements at the present rate of demand. The plants were now operating at approximately two-thirds of capacity, which was a little over 300 million lb. of nickel per annum. Dr. Thompson looked to 1959 with optimism with regard to nickel requirements, but the company had no immediate plans to reinstate any part of the cutbacks in production.

On copper, the chairman said that the company was sold out, but that future operations would be determined by the demand for nickel, and copper would remain a by-product. On platinum, Dr. Thompson said that the market was at present in a very depressed state, with cheaper Soviet offers dominating the supply position. It was the general belief that the Soviet sales were prompted by the need for "cash," and that they would probably be withdrawn when sufficient foreign currency had been realized.

New Company

It has been reported that the Cincinnati Shaper Company, of Ohio, U.S.A., has formed a British company to produce Cincinnati press brakes and guillotine shears. **The Cincinnati Shaper Co. Ltd**, a wholly-owned British subsidiary of the American company, recently moved into a specially constructed works in the new town of East Kilbride, eight miles from Glasgow.

The company is commencing production with ¼ in. capacity guillotine shears and 90 and 150 tons press brakes, but production will be extended to cover the complete range of shears up to 1 in. and 1½ in. capacity, and press brakes up to a capacity of 1,400 tons.

Rolling Mill Plant

As part of the expansion programme for their Rogerstone works, Northern Aluminium Company Ltd. have ordered from the Heavy Plant Division of **Associated Electrical Industries Ltd.,** a number of large electric drives for rolling mills. In addition to the main drive equipment, A.E.I. are also supplying all the auxiliary drives, including a special hot coiler equipment. Most of the electrical equipment will be built at the firm's Rugby works.

Special Sima Occasion

Harrogate is to be the venue of this year's Convention organized by the **Scientific Instrument Manufacturers' Association** and to be held at the Hotel Majestic in that town on November 6, 7, 8 and 9 next. This event has been designed this year to get the views of a large body of big instrument users representing a majority of those engaged in research and production in the various industries covered. The main theme of the occasion is based on—more instrumentation, better productivity, lower costs, and higher exports.

At this convention the major user industries — iron and steel, oil and chemicals, textiles and fibres, fuel and power—will be getting together with the instrument manufacturers.

Business Efficiency

An interesting display of aids to business efficiency is being made at the Engineering Centre, Stephenson Place, Birmingham, from Tuesday next, Novem- 4, until Thursday, November 6, by **M.B.C. (Office Systems) Ltd.,** of Colchester.

The theme of the exhibition is "Time and Space Saving," and exhibits include systems for drawing, card recording and indexing, drafting, document collating, letter filing, plan filing and storage, planning, visual charting, etc., with steel office and drawing office furniture, and featuring drawing office layout.

The Brussels Exhibition

At the conclusion of the 1958 Brussels Exhibition, the 87 firms exhibiting on the **Birmingham Engineering Centre's** collective exhibit in the British Industry Pavilion gained a total of 28 awards—three Grand Prix, four Diplomas of Honour, six gold medals, eight silver medals and seven bronze medals.

Among the recipients of these awards were the following: Rozalex Ltd. (bronze medal); Magnesium Elektron Ltd. (gold medal); G.W.B. Furnaces Ltd. (gold medal); and The Morgan Crucible Co. Ltd. (Diploma of Honour).

These awards were a highly satisfactory ending to what has been a very successful experiment for, during the six months' duration of the Fair, 1,500 firm enquiries for the products shown in the section have been received, and after processing by the Engineering Centre in Birmingham, have been passed on to the exhibiting firms.

Fabrication of Beryllium

Some significant advances in the fabrication of beryllium for the nuclear engineering industry are reported from the **Tube Investments Technological Centre** at Walsall. Development work has been in progress at the Centre and its new beryllium laboratory for a year, and the results up to date include:—

What is believed to be the longest small-bore beryllium tube yet produced. The bore is 0·3 in.; the wall thickness 0·04 in., and the tube is between 2 to 3 ft. long.

A very thin-walled beryllium tube, with a diameter of 0·7 in. and wall thickness of 0·012 in. in lengths of 2 to 3 ft.

Beryllium tubes of 8 to 10 ft. long, with a wall thickness of 0·08 in. upwards, and diameters of ½ in. upwards.

Beryllium rod and wire have also been produced. Work is now in hand in T.I. to investigate the material properties caused by different methods of processing beryllium with a view to establishing the best production process for tubes in this metal.

Bronze and Brass Founders

On Monday next (November 3), members of the London area section of the **Association of Bronze and Brass Founders** will hold an open meeting at the Clarendon Restaurant, Hammersmith, London, W.6, at 7.15 p.m. At this meeting the methods advocated in "Costing a Casting" (mentioned in the last issue of this journal) will be explained, discussed, and questions dealt with.

A Nickel Exhibition

A four-day exhibition, the theme of which is the properties and uses of nickel, nickel alloys and related materials, is to be held at the College of Aeronautics, at Cranfield, from Tuesday, November 18 next. This event is being organized by **The Mond Nickel Company Ltd.,** and is open to all industrial and commercial organizations in the area.

It is understood that coaches will be running a shuttle service between the college and the main line railway stations at Bedford and Luton. Arrangements have also been made for the college itself to be open each afternoon for any visitors wishing to make a tour of inspection.

The exhibition, which will include numerous working demonstrations and displays, has been designed to inform engineers, designers, metallurgists and students of the latest developments in this field. Invitations and coach times are available from the company at Thames House, Millbank, London, S.W.1.

Floodlighting Niagara Falls

To increase the light and improve the colour effects of the floodlighting display at Niagara Falls, a Canadian associate of The General Electric Company Ltd. has installed 20 high-intensity floodlights which have been developed and supplied by Savage and Parsons Limited, of Watford, Herts.

Since the units have to withstand considerable spray (and ice during cold weather), the manufacturing processes had to take this into account. Each 42 in. diameter lamphouse was made almost exclusively from Birmabright—chosen for its corrosion resistance. Argonarc welding equipment supplied by **British Oxygen Gases Ltd.** was used for the fabrication of the lamp barrels, front glass rings, box section frames for service doors, and air vent tubes for the cooling systems.

In order to manufacture lamp barrel support brackets, 16 S.W.G. panels were welded on to the frames, and these were

fabricated from $\frac{3}{16}$ in. thick Birmabright angle. A steel block clamped near the weld area conducted heat away from the thin sheet, and the welder employed a step sequence to help prevent distortion.

Canadian Refinery

Recent news from Toronto is to the effect that the Tonolli Company of Canada Limited has announced the purchase of a 20 acre site in Toronto township. The company, which was incorporated this summer, is backed by Swiss interests and will begin work soon as a secondary non-ferrous metal refinery of 40,000 ft^2 floor area. An investment of over one million dollars is planned as substantial expansions are added to this initial unit. Technical assistance with the set-up and operation of the plant will be supplied by A. Tonolli and Cie, Milan, Italy. Equipment will be purchased from both Canadian and Italian sources, and certain techniques developed by the Italian firm will be incorporated. It is expected that the plant will be in production about a year from now.

Aluminium Prefabrication

Details of a building embodying a completely new technique of prefabricated construction were released last week by **Coseley Buildings Ltd.** The building—a single-storey house—has been designed to give all the advantages of prefabricated construction. Modular construction allows for variation in external and internal dimensions; components can be extended by using multiples of a basic unit. Certain basic designs will be available presenting the standard construction to its best advantage and giving the benefit of the lowest prices. Alternative forms of internal partitioning will be available at different prices.

The prototype building is 40 ft. long with a 20 ft. span, and 9 ft. to eaves. The basic wall construction is a composition panel with insulation infilling. The walls are designed in conjunction with an aluminium framework. The roof is of "stressed skin" construction, using specially designed aluminium sheeting, which is carried beyond the eaves on both sides of the house to form covered verandahs over its complete length. Special curved sheets are used at the roof apex to improve the appearance. The main material used in construction is aluminium.

Aluminium Engine Blocks

According to recent news from New York, a representative of General Motors Corporation has stated that the aluminium automobile engine block is a distinct possibility in the near future.

It is said that the increasing use of aluminium in motor car production would be hastened by the trend to lighter weight cars, because of the increasing emphasis on reducing weight without decreasing roominess and performance.

Annual Luncheon

Hereford was the venue of the annual luncheon of the **Midland Metal and Allied Trades' Association,** under the chairmanship of **Mr. Felix E. D. Burke,** President of the association. He was supported by **Mr. J. W. Bush,** President of the Waste Trade Federation, **Mr R. O. Barnett,** President of the National Association of Non-Ferrous Scrap Metal Merchants, **Mr. E. W. Pugh,** President of the Midlands Scrap Iron, Steel and Metal Merchants' Association, and **Mr. C. A. Robinson,** past-president of the London and Southern Scrap Iron and Non-Ferrous Metal Merchants' Association.

The toast of the "Waste Trade Federation" was proposed by **Mr. W. Harvey Metcalfe,** and replied to by Mr. J. W. Bush. The toast of the "Midland Association" was proposed by Mr. R. O. Barnett, and the response was made by Mr. Felix E. D. Burke. Newly-appointed vice-president of the Midland Association, **Mr. C. M. Burley** proposed the toast of "The Guests," to which reply was made by Mr. C. A. Robinson.

Oil-Firing Course

A three-day course on fuel oil-firing, arranged by the **National Industrial Fuel Efficiency Service,** is to be held on Tuesday, Wednesday and Thursday, January 13, 14 and 15, 1959, at the Reading office of N.I.F.E.S. The course has been designed to meet the needs of industrial plant engineers, heating engineers and supervisory staff responsible for oil-fired boiler plants. Similar oil-firing courses held previously have been attended by more than 650 students.

The fee for the course, exclusive of hotel accommodation, will be six guineas. Application forms, and a course syllabus, may be obtained from the offices of N.I.F.E.S., 71 Grosvenor Street, London, W.1.

Public Works Exhibition

On Monday, November 10 next, the **Public Works and Municipal Services Congress and Exhibition** will be opened at Olympia, London, by the Rt. Hon. Henry Brooke, M.P., Minister of Housing and Local Government. The exhibition will be open daily until November 15 from 10 a.m. to 6.30 p.m.

Pyrometric Equipment

Incorporated into a limited liability company as from October 1 last, **Pyrometric Equipment Co. Ltd.** has taken over the assets of Dr. H. Elliss, who founded the original company some ten years ago. He developed it from being a metallurgical consultant's business to a general laboratory supply house, specializing in furnaces and thermocouples which they manufacture themselves. They are also agents or stockists for all the leading manufacturers of laboratory supplies.

The new company has been formed with a view to consolidating the expansion and development which is taking place in the business of laboratory supplies, and the manufacture of electric furnaces and thermocouples for heat-treatment, laboratory work, and all other applications where furnaces are necessary.

Soviet Copper Deposit

A copper deposit has been discovered at Gaisk, some 10 miles from Orsk, in the southern Ural region, the Economic and Industrial Gazette reports. A concentrator is being set up in the district which will supply local copper smelters with copper concentrate.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of the week to October 25 totalled 17,652 tons, comprising London 6,125, Liverpool 10,017, and Hull 1,510 tons. A week earlier, the total was 17,609 tons, of which 6,133 were held in London, 9,966 in Liverpool, and 1,510 tons in Hull.

Copper stocks totalled 8,234 tons, and comprised London 4,900, Liverpool 2,709, Birmingham 175, Manchester 300, and Swansea 150 tons. At the end of the preceding week the copper stock position was 8,919 tons—London 5,099, Liverpool 3,195, Birmingham 175, Manchester 300, and Swansea 150 tons.

Resistance Casting

Recently demonstrated at the open day of the British Welding Research Association, Abington, a discovery in resistance welding, provisionally patented, is now being developed there. The discovery evolved directly from work done at Abington for the United Kingdom Atomic Energy Authority. In spot welding, molten metal is expelled if the welding current is too high, or if the electrode force is too low. This molten metal can be directed into a cavity in the welding face of an otherwise normal spot welding electrode. Since it freezes there to form a stud, strongly welded to the parent sheet, the technique is known as resistance casting, or sometimes as stud raising, or pimple welding.

Studs of highly varied shapes and sizes have been formed by this process in a wide range of metals, including steel, stainless steel, light alloys, titanium, and nickel alloys. A peg of similar or different material, inserted in the electrode cavity, can be cast into the stud; strong metallic bonding between the peg and stud can occur with compatible metals, though the purely mechanical joint formed with non-metallic pegs may also be strong. If both electrodes are provided with a cavity, projections will be formed on both sides of the article. Since the metal for the stud is drawn from the molten spot weld nugget, it is generally necessary to have at least two sheets of metal between the spot welding electrodes in order to raise a stud.

It is proposed to undertake a survey of possible industrial applications for the new process, but some are already obvious. Among the less obvious ones are the raising of projections on tubes or flat surfaces to form heat exchangers. Projections suitable for projection welding can be made by resistance casting on metal too thick to be raised by pressing.

Lead and Zinc Talks

According to recent reports from Geneva, a United Nations conference on lead and zinc will commence in that city on November 10 next. This meeting will be the natural follow-up of the earlier talks, held in London last month, when delegates from the participating countries presented their views on import restrictions imposed by the U.S.A. Government, and the consequent decrease in production.

Non-Ferrous Club

On Wednesday next, November 5, the monthly luncheon meeting of **The Non-Ferrous Club** will be held at the Queen's Hotel, Birmingham. The guest speaker on this occasion will be Councillor A. M. Beaumont Dark, who is an investment adviser and a member of one of the leading firms of stockbrokers in Birmingham. He will speak on the subject of "The Stock Exchange."

Australian Uranium

An important event in the industrial life of Australia took place on Monday last at Brisbane, when **Mr. Robert**

Menzies, the Australian Prime Minister, officially opened the Mary Kathleen Uranium Limited project. The Prime Minister stated at the ceremony that the first shipment of some 100 tons of uranium oxide was already on its way to the United Kingdom for the British Atomic Energy Authority. This shipment is said to be three months ahead of the planned schedule.

Purchasing Officers

Purchasing officers from five countries met recently in Düsseldorf and decided to form the **European Federation of Purchasing Officers.** The delegates, from the United Kingdom, Germany, France, Holland and Sweden, are setting up this new body to represent their countries' interests in international affairs, and to encourage "the development and improvement of both the practice and the science, as well as the standing and ethics, of purchasing as a basic and distinct function of the management structure in trade, industry, and public administration." For the time being, Mr. J. R. Blinch, secretary of the British Purchasing Officers' Association, will be acting secretary of the new body.

Molybdenized Lubricants

Described as a complete guide to the use of a vast range of molybdenized lubricants for industry, ranging from aircraft at one end of the scale to watches and clocks at the other end, a revised publication entitled "Rocol Molybdenized Lubricants" has just been issued by **Rocol Limited.**

In the space of just under a decade, this company has developed and invented 28 specialized lubricants using molybdenum disulphide. The publication explains what this is, and why, and gives its physical properties and commercial specification. The full range of these lubricants is described in terms of easy comprehension.

Some proofs of the quality of the lubricants are given, and an extremely interesting list of the numerous general uses of the firm's products. Some industrial examples are also given, the cases including precision engineering, aeronautical engineering, steam engineering, light and heavy engineering, and chemical engineering.

The Telex System

It is announced by **Griffin and George Ltd.** that they are now connected to the Telex system at their Alperton warehouse (Telex 21126) and at their Birmingham warehouse and works (Telex 33-033). It is understood that their other provincial branches will be connected as soon as the installations are complete.

A Ministry of Science

At the second annual meeting of scientific societies in South Wales and Monmouthshire, to be held this year on Friday, November 21, in the Reardon-Smith Lecture Theatre, The National Museum of Wales, Cardiff, at 7.30 p.m., the address will be given by **Sir Hugh Beaver,** K.B.E., LL.D., whose subject will be "A Ministry of Science."

The Lord Mayor of Cardiff will open the meeting, and among the societies represented will be the Chemical Society, the Institute of Metals, the Institute of Physics, the Institution of Chemical Engineers, the Royal Institute of Chemistry, the Society of Instrument Technology, the Society of Chemical Industry, and the Society of Analytical Chemists.

Half-Yearly Meeting

We are informed that the December half-yearly meeting of the **National Association of Non-Ferrous Scrap Metal Merchants** is to be held in Birmingham, at the Midland Hotel, on December 3 next, at 2.30 p.m.

Merchandise Marks Act

It has been announced by the Board of Trade that, in pursuance of Section 7 of the Merchandise Marks Act, 1926, a draft Order in Council prescribing additional methods of indicating the origin of imported refractory bricks, blocks and tiles not made from molten material was laid before Parliament on Tuesday last. This draft Order, it is understood, is intended to extend the provisions prescribed in the Merchandise Marks (Imported Goods) No. 4 Order, 1930.

Atomic Energy Patents

In succession to Mr. T. Benson Gyles, **Mr. J. A. Gay** has been appointed Patents Exploitation Officer to the United Kingdom Atomic Energy Authority.

Inventions developed in the course of atomic energy work, and which are available for commercial exploitation continue to be filed at the rate of about eight a month. Many of them may be applied in a wide variety of industries, both inside and outside atomic energy, and the total number of inventions available for use by firms is now well over 400. Application for details of such inventions should be made to Mr. Gay at the United Kingdom Atomic Energy Authority, 11 Charles II Street, London, S.W.1.

Japanese Manganese Market

News from Tokyo is to the effect that the Japanese Government is likely to authorize imports of about 60,000 tons of manganese ore shortly under the import Budget covering the second half of the fiscal year (October-March). Japan's output of manganese products during September totalled 22,665 tons, comprising 11,213 tons of high-carbon ferromanganese, 2,439 tons of low- and medium-carbon ferro-manganese, 8,439 tons of silicon manganese, and 574 tons of metallic manganese, according to the Japan Ferro-Alloy Association.

The September output compared with a total of 19,680 tons, including 9,572 tons, 1,731 tons, 7,881 tons, and 496 tons respectively in August, the Association said.

Copper Production in U.S.

U.S. mine production of copper is being stepped up substantially to take care of increased demand, as well as to help offset shortages of the metal created by prolonged strikes at mines in Rhodesia, Canada, and the U.S., it was reported in New York.

The rise in American mine output, one copper official is quoted as saying, is to provide a check to a possible runaway market, and to make copper available at a reasonable price. An estimated 24,000 tons of copper a month is being added to U.S. mine output in the moves. This total could be swelled several thousand tons more, industry men say, with the monthly figure getting well above 90,000 tons a month.

The strikes in Rhodesia, Canada and the U.S., it is said, have caused a cumulative loss of an estimated 67,000 tons of copper. The strike at the five big Northern Rhodesian copper mines has lasted six weeks. The mines had been producing about 37,500 tons of copper a month.

Fuel Economy Installations

The Treasury have made the Investment Allowances (Fuel Economy Plant) Order, 1958. Section 15 (3) (b), Finance Act, 1956, provides that investment allowances are to be continued for expenditure incurred after February 17, 1956, on prescribed fuel-saving plant if it is installed by way of modification or replacement of plant in use in the United Kingdom. The Investment Allowances (Fuel Economy Plant) Order, 1957 (which superseded an earlier Order) prescribes a list of fuel-saving plant and the conditions, if any, upon which such plant is prescribed.

The present Order, as from the date when it came into operation, prescribes the following additional items:—(a) gas-tight sealing dampers; (b) necessary operating equipment for gas-tight sealing dampers, of types not suitable for use in connection with other dampers.

The Order came into operation on October 25 last, and has been published as Statutory Instruments 1958, No. 1726.

Forthcoming Meetings

November 3—Plastics Institute. Midland Branch. Grand Hotel, Leicester. "P.V.C. Coated Metals." W. E. Martin. 6.45 p.m.

November 4 — Incorporated Plant Engineers. Peterborough Branch. White Lion Hotel, Church Street, Peterborough. "The Clean Air Act." J. Hall. 7.30 p.m.

November 5 — Manchester Metallurgical Society. Manchester Room, Central Library, Manchester. "Temperature Measurement." J. A. Hall. 6.30 p.m.

November 5—Institution of Production Engineers. Dundee Section. The New Imperial Hotel, Tally Street, Dundee. "Powder Metallurgy." G. R. Bell. 7.30 p.m.

November 6—Institution of Production Engineers. Reading Section. The Canteen, Transport Equipment (Thornycroft) Limited, Basingstoke. "Making Jigs, Tools and Moulds in Epoxide Plastics." P. G. Pentz. 7.30 p.m.

November 6—East Midlands Metallurgical Society. College of Art, Green Lane, Derby. "Titanium—A Broad Survey." P. L. Teed. 7.30 p.m.

November 6 — Polarographic Society. First Floor Lounge, The Duke of York, 8 Dering Street, London, W.1. "Some Problems Encountered in the Polarography of Metallic Cations in the Presence of Bis-Quaternary Compounds." P. O. Kane. 7 p.m.

November 6—Institute of Metals. London Section. Royal School of Mines, South Kensington, London, S.W.7. "Experimental Features of Investigations with Radio-Active Materials." J. G. Ball. 7 p.m.

November 6 — Leeds Metallurgical Society. Lecture Room "C," Chemistry Wing, The University, Leeds, 2. "Aluminium Bronzes." C. V. Wilson. 7.15 p.m.

Metal Market News

FEATURES of the situation last week were the boil over on Wall Street, where losses were quite considerable, and the sharp reaction on Wednesday in copper, which on the day dropped by £6 10s. 0d. By the time this happened, however, the cash price of the metal had advanced to £250, and at midday on Tuesday the settlement price was £251. Wednesday, too, saw great activity in copper futures on the New York market, where 700 lots changed hands, with a loss, however, of something like 80 points. The setback in London seems to have been due to reports that there were better prospects of a settlement in Rhodesia, but progress towards a return to work has been very slow, and the loss in production must have been more than 50,000 tons. No news has come through from Canada, and there are apparently no prospects of any conclusion of the dispute. The week opened with a drop of 681 tons in stocks of copper in L.M.E. warehouses to 8,919 tons, and the prospect of a further reduction. Tuesday brought news that the talks at Kitwe had been suspended for 24 hr. to permit of discussions by the two parties, but there was also the announcement of an advance of 1½ cents in the smelters' quotation to 30 cents. At the beginning of the week, too, there was a rumour about a possible wild cat strike at the Phelps Dodge plant. Throughout the week there was a good deal of what is usually called influential selling on the market. Thursday's report of American markets listed the price of electro as quoted by the producers at 27½ to 29 cents. In fact, Kennecott and Anaconda had advanced to 29 cents, and the following day Phelps Dodge fell into line.

Thursday brought a reaction on news that Kennecott was increasing production to a seven-day week, and also on hopes of a speedy settlement in Rhodesia. In active trading, the settlement price was listed at £241, with three months at £233 15s. 0d., but in the afternoon there was an improvement to £244 cash and £237 10s. 0d. forward, but after official trading, values were lower on the Kerb. Earlier in the week there had been good buying, both in the U.K. and on the Continent, but the setback in values from the peak of £250 frightened buyers off. On Friday, trading in copper was again brisk, but the firm opening, due to adverse reports about the progress of events in Rhodesia, was not maintained, and values fell away. For one thing, it seemed that buyers were not inclined to cover much metal at the higher price, for there was undoubtedly a feeling that the strike is very near an end. It looks as if only arbitration will succeed in bringing this long drawn-out dispute to an end. After an exceptionally heavy turnover of nearly 20,000 tons, including Kerb business, cash registered on balance a gain of £1 at £244, while three months was £2 up at £237 5s. 0d.

Tin was a firm market throughout the week, and spurted on Thursday and Friday to finish the week at £747 10s. 0d. cash and £743 three months, these prices showing gains on balance of £8 10s. 0d. in cash and £9 10s. 0d. in three months. Consumer buying has been better, and the better reports from the United States helped to cheer the London market. Lead closed below the best and was a good deal influenced in its fluctuations by the erratic movements in copper. October closed at £76, being 15s. up, while January was unchanged at £75 15s. 0d. Zinc put up a reasonably good show to close £2 up at £73 for the current month, and £1 7s. 6d. better for January at £71 10s. 0d.

Birmingham

At last week's meeting of the Midland Regional Board for Industry, the chairman, Major C. R. Dibben said that there was a feeling that the bottom of the slight recession had been reached. There was confidence about future prospects, although at the same time there was doubt whether that confidence was justified by the evidence available. Unemployment in the area is the worst since the fuel crisis. The total number on the register is 40,307, and vacancies have fallen to 16,588. The metal-working industries, with a few exceptions, are working short time. On the other hand, there seems to be some improvement in domestic hollow-ware. In the first nine months of the year there has been a 40 per cent drop in new factory building approvals compared with last year.

Another section of the iron and steel industry to feel the effect of trade recession is that concerned with tube production. A steel tube mill which recently went on a four-day week is to change from three-shift to two-shift working in November. There will be no redundancy, however, as the 30 men employed will be transferred to other departments. Steel is being absorbed by the motor trade in good tonnages, and this business is likely to continue without interruption. In other consuming trades, however, the tendency is to continue using stocks, partly because of the uncertain outlook, and also because there are still hopes of lower prices. The possibility of this, however, seems remote having regard to high production costs.

New York

Leading custom smelters reported light sales of copper at the end of last week. Meanwhile, at least two of the leading producers were finding difficulty in supplying copper for their orders. Phelps Dodge were still crippled by the strike at El Paso Refinery, and Kennecott were just pulling out of the Chino shutdown, with officials there studying production schedules and trying to find the copper to fill their orders. Anaconda also indicated difficulty in meeting the large nearby orders. Copper futures were better on the breakdown of the Rhodesian talks. Fabricators have raised their copper products prices to reflect the 29 cents copper price.

The tin undertone was steadier but quiet, with some traders denoting a softer trend developing in the afternoon. Lead was quiet, and zinc routinely active.

Rhodesia

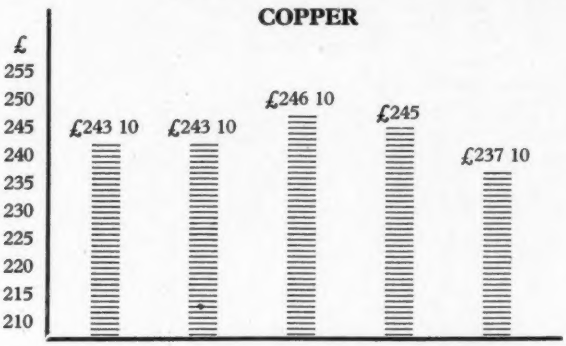
It is learned from Salisbury that on Monday last the Federal Rhodesian Prime Minister, Sir Roy Welensky, sent a cable to the chairman of the Northern Rhodesian European Mineworkers' Union and the President of the Rhodesian Chamber of Mines asking that both parties, in their own and in the national interest, should agree to return to work. Copies of the Premier's cable were also sent to the Governor of Northern Rhodesia, Sir Arthur Benson, and to the leader of the unofficial members of the Northern Rhodesia Legislative Council, Mr. John Roberts. In his cable, Sir Roy said the constitutional position was clear. As Federal Prime Minister he had no right to intervene in any industrial dispute, and in normal circumstances he would have continued his silence. But he could no longer stand aside and see the present grave situation continue whereby the major industry of the Federation had ceased to operate and thousands of workers were unemployed. The whole Federation was now feeling the repercussions of the strike, and it was in the national interest that the union and the companies should agree on a return to work.

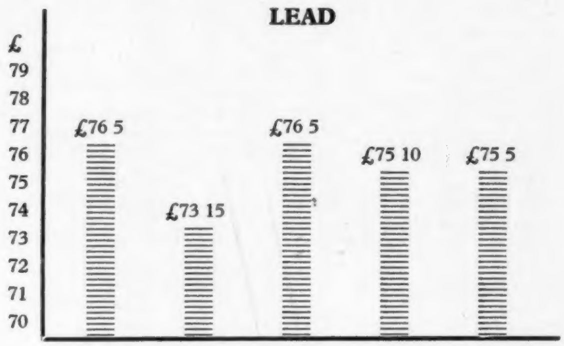
Talks between the companies and the union, under the independent chairman, Lt.-Col. Eric Gauron, broke down for the second time in a week last Friday. Over the week-end, a member of the Northern Rhodesia Executive Council for Mines, Mr. Billy Dunlop, suggested that the companies and the union should accept Col. Gauron as an arbitrator on the dispute. If they did so, he said, the mines could be working again to-morrow.

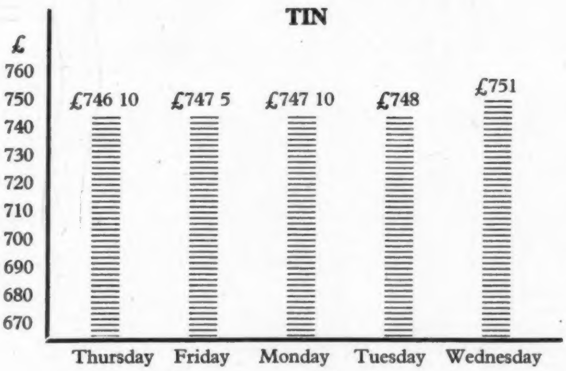
The union said on Monday they would accept Col. Gauron as an arbitrator as long as his decisions were binding on both parties. But the companies said they would only welcome his opinions, and that the question of arbitration was not the issue at stake.

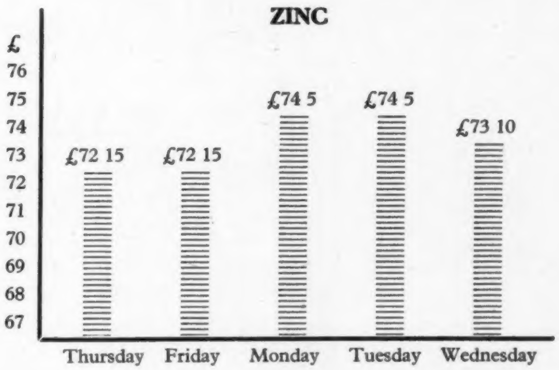
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 23 October 1958 to Wednesday 29 October 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		**Canada** c/lb ≏ £/ton		**France** fr/kg ≏ £/ton		**Italy** lire/kg ≏ £/ton		**Switzerland** fr/kg ≏ £/ton		**United States** c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.80	214 10
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,500	1,305 0					145.00	1,160 0
Copper												
Crude												
Wire bars 99.9							470	272 12 6				
Electrolytic	33.75	246 15	28.25	233 7 6	290	252 7 6			3.00	250 17 6	29.00	232 0
Lead			11.25	93 0	115	100 0	186	107 17 6	.91	76 0	13.00	104 0
Magnesium												
Nickel			70.00	578 5	1,205	1,048 7 6	1,300	754 0	7.56	632 2 6	74.00	592 0
Tin	104.25	762 0			916	797 0	1,430	829 10	8.70	727 10	97.25	778 0
Zinc												
Prime western			11.00	90 17 6							11.00	88 0
High grade 99.95			11.60	95 17 6								
High grade 99.99			11.60	95 17 6								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	174	101 0	.92	77 0	12.25	98 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 2 p.m. 29/10/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite per unit			—	
Copper H.C. Electro	ton	237	10	0
Fire Refined 99·70%	„	236	0	0
Fire Refined 99·50%	„	235	0	0
Copper Sulphate	„	76	0	0
Germanium	grm.	—		
Gold	oz.	12	10	0¼
Indium	„		10	0
Iridium	„	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	75	5	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	290	0	0
Mercury	flask	78	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.	nom.		
Osmiridium	„	nom.		
Palladium	„	5	15	0
Platinum	„	21	5	0
Rhodium	„	40	0	0
Ruthenium	„	15	0	0
Selenium	lb.	nom.		
Silicon 98%	ton	nom.		
Silver Spot Bars	oz.		6	6½
Tellurium	lb.		15	0
Tin	ton	751	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	72	10	7½
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	97	10	7½
Granulated 99·99+%	„	111	7	6

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	144	0	0
B.S. 1490 L.M.2	„	152	0	0
B.S. 1490 L.M.4	„	169	0	0
B.S. 1490 L.M.6	„	187	0	0

†Average selling prices for mid September

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	234	0	0
BSS 1400 AB.2	„	256	0	0
***Brass**				
BSS 1400-B3 65/35	„	155	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	200	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5)	„	196	0	0
(86/7/5/2)	„	203	0	0
(88/10/2/1)	„	254	0	0
(88/10/2/½)	„	269	0	0
Manganese Bronze				
BSS 1400 HTB1	„	192	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„	215	0	0
Nickel Silver				
Casting Quality 12%	„	nom.		
„ „ 16%	„	nom.		
„ „ 18%	„	nom.		
***Phosphor Bronze**				
B.S. 1400 P.B.1 (A.I.D. released)	„	284	0	0
B.S. 1400 L.P.B.1	„	210	0	0
Phosphor Copper				
10%	„	255	0	0
15%	„	259	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	354	9	0
Grade D Plumbers	„	287	6	0
Grade M	„	388	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	104	12	6
Mazak V	„	108	12	6
Kayem	„	114	12	6
Kayem II	„	120	12	6
Sodium-Zinc	lb.		2	6

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8
Sheet 18 S.W.G.	„		2	10
Sheet 24 S.W.G.	„		3	1
Strip 10 S.W.G.	„		2	8
Strip 18 S.W.G.	„		2	9
Strip 24 S.W.G.	„		2	10½
Circles 22 S.W.G.	„		3	2
Circles 18 S.W.G.	„		3	1
Circles 12 S.W.G.	„		3	0
Plate as rolled	„		2	7½
Sections	„		3	1½
Wire 10 S.W.G.	„		2	11
Tubes 1 in. o.d. 16 S.W.G.	„		4	0

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0½
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10½
Strip 10 S.W.G.	„		3	0½
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477. HP30M.				
Plate as rolled	„		2	10½
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	6½
Sheet 18 S.W.G.	„		4	0½
Sheet 24 S.W.G.	„		4	10½
Strip 10 S.W.G.	„		3	9½
Strip 18 S.W.G.	„		4	0½
Strip 24 S.W.G.	„		4	8
BS1477. HPC15WP.				
Plate heat treated	„		3	5½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	9½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP.				
Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	11⅛
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	255	15	0
Extruded Bar	lb.		2	0¾
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	191	0	0
Condenser Plate (Naval Brass)	„	202	0	0
Wire	lb.		2	8⅝
Copper Tubes	lb.		2	4⅝
Sheet	ton	277	5	0
Strip	„	277	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	292	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	7⅞
Lead Pipes (London)	ton	117	10	0
Sheets (London)	„	115	10	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	8¾
Wire 10%	„		4	3½
Phosphor Bronze				
Wire	„		4	2

Titanium (1,000 lb. lots)			
Billet over 4" dia.-18" dia.	lb.	63/-	64/-
Rod 4" dia.-·250" dia.	„	75/-	112/-
Wire under ·250" dia.-·036" dia.	„	146/-	222/-
Sheet 8'×2'×·250"-·010" thick	„	88/-	157/-
Strip ·048"-·003" thick	„	100/-	350/-
Tube (representative gauge)	„		300/-
Extrusions	„		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	108	5	0
Strip	„	nom.		

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 28/10/58.

	£
Aluminium	
New Cuttings	134
Old Rolled	110
Segregated Turnings	90
Brass	
Cuttings	144
Rod Ends	140
Heavy Yellow	121
Light	116
Rolled	133
Collected Scrap	119
Turnings	133
Copper	
Wire	204
Firebox, cut up	200
Heavy	195
Light	190
Cuttings	203
Turnings	183
Braziery	161

	£
Gunmetal	
Gear Wheels	188
Admiralty	188
Commercial	163
Turnings	158
Lead	
Scrap	67
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	163
Turnings	158
Zinc	
Remelted	55
Cuttings	42
Old Zinc	30

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£195.17.6)	225
Heavy copper	(£191.10.0)	220
Light copper	(£161.0.0)	185
Heavy brass	(£119.2.6)	137
Light brass	(£91.7.6)	105
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£213.2.6)	245
Heavy copper	(£213.2.6)	245
Light brass	(£143.10.0)	165
Zinc castings	(£61.0.0)	70
Lead	(£82.12.6)	95
Tin		—
Aluminium	(£117.10.0)	135

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£194.7.6)	335
Aluminium copper alloy	(£124.15.0)	215
Lead, soft, first quality	(£87.0.0)	150
Lead, battery plates	(£51.0.0)	88
Copper, first grade	(£211.15.0)	365
Copper, second grade	(£197.5.0)	340
Bronze, first quality machinery	(£206.0.0)	355
Bronze, commercial gunmetal	(£177.0.0)	305
Brass, heavy	(£145.0.0)	250
Brass, light	(£133.10.0)	230
Brass, bar turnings	(£142.2.6)	245
New zinc sheet clippings	(£58.0.0)	100
Old zinc	(£43.10.0)	75

Financial News

Metal Traders Ltd.

Group net profit £136,300 (£202,283) year ended March 31, 1958. Dividend 37½ per cent (50) and bonus 12½ per cent (nil). Group forward £361,720 (£348,344). Fixed assets £237,382 (£244,574). Current assets £3,115,280 (£4,394,674), including balance of transactions with companies having balance sheets at dates prior to March 31, 1958, £28,721 (nil) and cash £393,591 (£330,211). Current liabilities £1,954,469 (£3,250,329), including bank loans £84,051 (£135,805). Commitments £15,000.

Capper Pass and Son Ltd.

Final dividend 2 per cent, making 8 per cent year to March 31, 1958 (same). Group net profit £26,932 (£120,843). Fixed assets £990,958 (£1,020,145), trade investments £171,017 (£218,688), and net current assets £2,114,750 (£2,180,032). Capital expenditure during year £91,943 (£112,840).

Tin Levy in Malaya

Recent news from Singapore is to the effect that during the tenth period, November 1-30, Malayan miners will pay levy of $M21 per picul (unchanged) towards repayment of Federation contributions to the International Tin Buffer Stock.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Willbro Metal Co. Limited (611467), 68 Argyle Street, Birkenhead. Registered September 18, 1958. Nominal capital, £1,000 in £1 shares. Directors: Joseph D. Hislop, Thomas J. Williams, Fredk. J. Williams and Bernard J. Murphy.

Willochrome Limited (661468), 3-7 Cross Lane, Earlestown, Newton-le-Willows, Lancs. Registered September 18, 1958. To carry on business of electroplaters, etc. Nominal capital, £1,000 in £1 shares. Directors: Thomas H. Daniels, Mrs. Joan Daniels and Percival G. Preston.

G.B. (Enamelling) Limited (611483), 1 Dunraven Street, W.1. Registered September 18, 1958. To carry on business of enamellers, metal sprayers, etc. Nominal capital, £100 in £1 shares. Directors: Gyula Balogh and Alfred V. Freeman.

Trade Publications

Controlled Atmosphere Batch Furnaces.—British Furnaces Ltd., Chesterfield.

A useful leaflet in colour is issued by this company descriptive of their "All-case" controlled atmosphere batch furnaces. The furnace is a batch type radiant tube heated furnace with recirculating fan and enclosed quench. It provides high production, controlled atmosphere heat treating at minimum capital investment. Two sizes of furnace are available. All these details are given in the leaflet, together with other essential data and diagrams.

Turret Punch Presses.—Dowding and Doll Ltd., 346 Kensington High Street, London, W.14.

In their latest catalogue this company describes the various useful accessories which it provides for users of British Wiedemann turret punch presses. Full details, diagrams and photographs are given of the units available.

Non-Ferrous Castings, Etc.—Williams Alexandra Foundry Ltd., East Moors Road, Cardiff.

A general idea of the range of non-ferrous castings and machined components which this company manufactures is given in a new booklet just produced, and includes productions in phosphor bronze, gunmetal, brass and aluminium. Rods, tubes, sheets, sections, in these various metals are detailed, together with statistics and photographs.

Colour Anodized Aluminium. — The Aluminium Development Association, 33 Grosvenor Street, London, W.1.

A folder provides a colour chart for light-fast weather resistant anodized aluminium. The colours shown indicate the available range using approved dyes and pigments. Some fifteen tints are detailed, with appropriate notes.

High Purity Metals.—Henry Gardner and Co. Ltd., 2 Metal Exchange Buildings, Leadenhall Avenue, London, E.C.3.

A new booklet entitled "High Purity Metals," issued by this company describes in some detail the current range of such metals produced by the Consolidated Mining and Smelting Company of Canada Ltd. These metals include bismuth, cadmium, indium, lead, silver, tin, and zinc. Also special research grade indium and special research grade antimony. Tadanac brand high purity metals are relatively new Cominco developments, and this booklet of twelve pages provides a good deal of introductory information about them.

Titanium.—Imperial Chemical Industries Limited, Imperial Chemical House, Millbank, London, S.W.1.

Standard sizes of titanium rod, bar and billet are set out in a four-page leaflet. I.C.I. has installed a modern rolling plant of advanced design for the production of titanium rod to the closest possible tolerances. The opportunity has been taken to rationalize the range of rod, bar and billet sizes produced, and the standardized system now in operation will benefit customers in both price and delivery, as well as by simplifying ordering and handling.

THE STOCK EXCHANGE

Prices Moved Rather Erratically And Heavy Turnover Again Reported

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 28 OCTOBER	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	23/3	+3d.	9	10	7 14 9	23/3	17/6	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	53/6	—9d.	15	15	5 12 3	55/3	46/6	72/3	47/9
1,590,000	1	Birfield Industries	60/–	—2/4½	15	15	5 0 0	62/4½	46/3	70/–	48/9
3,196,667	1	Birmid Industries	71/–	—5/6	17½	17½	4 18 0	77/–	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	34/–	+1/1½	10	8	5 17 9	34/–	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	16/1½		5	5	6 4 0	16/1½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/1½		6	6	7 0 3	17/4½	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	26/3		12½	12½	9 10 6	28/9	24/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	16/–	15/–	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/–		7	7	7 0 0	19/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	51/–	—2/–	12	12	4 14 0	54/9	36/6	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/3		6	6	6 4 9	20/–	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	49/–	+9d.	12½	12½	5 2 0	49/–	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	43/6	—9d.	10	10	4 12 0	44/3	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	24/6	+1½d.	25+ *2¼C	25	5 2 0	24/6	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/7½	—1½d.	25	25	10 15 6X	2/3	1/4½	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	5/1½	+4½d.	25	25	9 15 0	5/1½	4/–	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	20/6	—3d.	10	10	9 15 0	20/9	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/6		6	6	7 14 9	15/10½	15/7½	17/6	16/–
250,000	2/–	Coley Metals	3/3		20	25	12 6 3	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	55/6	—2/3	18¾	22½	6 15 0	57/9	41/–	92/6	49/–
1,136,233	1	Davy & United	75/6		20	15	5 6 0	75/6	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	22/9	—9d.	30	*17½	6 11 9	23/9	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	36/–	—6d.	12½	15B	6 19 0	36/6	22/9	38/6	25/–
750,000	1	Evered & Co.	27/6		15Z	15	7 5 6	28/3	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	37/6	—1/3	10	12½	5 6 9	39/6	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	36/3		20	17½	5 10 3	37/6	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	66/3	+1/3	15	15	4 10 6	66/3	61/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	7/6	—3d.	11¼	11¼	7 8 3	7/9	5/6	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	17/–	—7½d.	20	20	5 17 9	17/7½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	25/9	—9d.	13‖	18Z	4 18 0	26/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	52/6	+1/9	20	17½	7 12 6	52/6	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	15/6	+3d.	*15	*15	4 16 9	15/6	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/–		7	7	7 7 3	19/–	18/9	22/3	18/7½
1,075,167	5/–	Heenan Group	9/6		10	20‡	5 5 3	9/7½	6/9	10/4½	6/9
236,953,260	Stk. (£1)	Imperial Chemical Industries ...	34/6	+3d.	12Z	10	4 12 9	34/6	27/7½	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/6	—3d.	5	5	6 1 3	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	160	—5	$3.75	$3.75	4 4 0	168½	132¾	222	130
430,000	5/–	Jenks (E. P.), Ltd.	8/9		27½ϕ	27½	7 17 3	8/9	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/9	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	41/6	—9d.	10	10	4 16 6	45/3	36/6	58/9	40/–
600,000	10/–	Keith, Blackman	22/6	—1/–	17½	15	7 15 6	23/6	15/–	21/9	15/–
160,000	4/–	London Aluminium	4/1½		10	10	9 14 0	4/4½	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	61/6	—2/6	12½	12½	4 1 3	64/–	39/9	54/6	41/–
400,000	1	Ditto Pref.	23/9		7½	7½	6 6 3	23/9	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	42/6		15	15	7 1 3	42/6	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	42/6		15	15	7 1 3	42/6	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	13/–	+7½d.	20	27½‡	7 13 9	13/–	8/9	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	6/3	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	59/6	—2/–	11	11	3 14 0	62/3	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	7/9	—6d.	50	50	12 18 0	8/9	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	20/–		10	10	10 0 0	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%	70/6		6	6	8 10 3	83/6	70/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	41/–		10	10	4 17 6	41/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/9	+6d.	5½	5½	6 4 0	17/9	17/–	19/3	16/–
2,200,000	Stk (£1)	Murex	53/9	—2/3	17½	20	6 10 3	58/9	47/9	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	11/–		10	10	4 11 0	11/–	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	25/3	+3d.	20	27½D	7 18 6	27/–	24/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	15/10½	—6d.	15	17½Z	4 14 6	16/10½	11/–	18/10½	11/6
6,698,586	Stk. (£1)	Stone-Platt Industries	38/9		15	12½	7 14 9	40/–	22/6	33/4½	22/7½
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/6		5½	5½	7 2 0	16/–	12/7½	14/–	12/9
14,494,862	Stk. (£1)	Tube Investments Ord.	71/6		17½	15	4 18 0	72/6	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	33/3	—4½d.	10	10	6 0 3	34/–	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 3	15/6	14/3	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/–	+3d.	*5	*5	7 0 3A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	87/–		20	15	4 12 0	87/–	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	41/6	—9d.	10	18P	4 16 6	42/9	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	9/9		30	25	5 2 6	9/6	7/1½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	21/3	—1/6	27½	27½	6 9 3	22/9	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	4/6	—3d.	20	17½E	11 2 3	4/10½	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	12/9		6	6	9 8 3	12/9	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	2/10½		27	40D	9 7 9	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11¼% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.